Full Length Research Paper

Morphological characterization of the pollens of the selected species of Genus *Prunus* Linn. from Northern Pakistan

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A total of 6 species of *Prunus* were studied for the morphological characterization of the pollens through the scanning electron microscopy (SEM). The species were collected from various parts of Northern Pakistan. The species included *Prunus armeniaca* L.*, Prunus bokhariensis* Royle ex C.K. Schn*, Prunus avium* L.*, Prunus persica* (L.) Batsch*, Prunus domestica* L. and *Prunus cornuta* (Wall. ex. Royle) Steudel. In the SEM of the pollens, variations were found in the shape and exine sculpturing. The pollen class ranged from trizonocolpate to obtus-triangular, and the exine sculpturing varies from striate-scabrate-reticulate. The pollen shape varied from triangular-acute-convex to triangular-obtuse-convex to circular in polar view and elliptic-acuminate-acute to elliptic-acuminate-obtuse in the equatorial view. All these variations were very useful in the identification of the species with respect to their pollen shape and class.

Key words: Palynology, scanning electron microscopy, *Prunus* species, Northern Pakistan.

INTRODUCTION

Rosaceae is a family of about 100 genera and 3,000 species. Members of *Rosaceae* occur in a variety of habitats throughout the world but the family is best developed in the Northern hemisphere (Judd et al, 1999) where it is also of tremendous economic importance. The vast majority of fruits of the North temperate regions including species of *Malus* Mill (Apples), *Pyrus* L. (pears), *Fragaria* L. (strawberries), *Rubus* L. (raspberries and blackberries) and *Prunus* L. (peaches, plums, cherries, apricots and almonds) are produced by species of *Rosaceae*. The family also includes many ornamentals, cultivated primarily for their beautiful flowers, such as species of *Rosa* L. (roses), *Potentilla* L. (chinquefoil), *Sorbus* L. (mountain ash) and *Spiraea* L. (bridal wreath) (Potter, 2003). Family *Rosaceae* is not yet published in the Flora of Pakistan and there is a lot of taxonomic work yet to be done for the proper classification and placement of different genera under different sub-families.

Most of the *Prunus* are edible as fruits along with few with medicinal importance. Apricot (*Prunus armeniaca*) kernel oil is used as an adulterant or substitute for almond oil and in medicine for earache and a variety of ailments (Chopra et al., 1956; Gupta, 1969). In Yunani system of medicine, it is used as antiarrohetic, emetic, anthelmintic, in liver diseases, piles, earache, deafness, as an expectorant, remedy for dry throat, lung diseases and abscesses (Prasad, 1999). It is also regarded as sedative for the respiratory centre, tonic and anti-spasmodic, a remedy for severe colds and bronchial asthma (Lily and Judit, 1980). The presence of pentacyclic triterpene acid along with its glycoside and antibacterial and antioxidant activity of triterpene acid and crude extract has been reported (Rashid et al., 2005). Stewart (1972) listed a total of 26 species including 23 species, 2 subspecies and 1 variety from West Pakistan. *Prunus* has both wild and cultivated species. *Prunus* is found in tropical to temperate and sometimes in moist temperate regions.

In the present study, scanning electron microscopy (SEM) was conducted to find out the morphological characterization of the pollens of the different species of

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Table 1. Pollen shapes and exine sculpturing in the *Prunus* species.

Plant species	Shape of pollen (Polar view)	Shape of pollen (Equatorial view)	Sculpturing of exine surface	Pollen class	Number of colpi
Prunus bokhariensis	Triangular-obtuse-convex-circular	Elliptic-acuminate-acute	Striate	Trizonocolpate Obtus-triangular	3
Prunus domestica	Triangular-obtuse-convex	Elliptic-acuminate-acute	Striate	Trizonocolpate Obtus-triangular	-
Prunus armeniaca	Triangular-obtuse-convex	Elliptic-acuminate-acute	Striate	Trizonocolpate Obtus-triangular	-
Prunus avium	Triangular-obtuse-convex- (straight)	Elliptic-acuminate-obtuse	Striate	Trizonocolpate Obtus-triangular	-
Prunus persica	Triangular-obtuse-convex	Elliptic-obtuse-convex-(circular)	Striate	Trizonocolpate Obtus-triangular	-
Prunus cornuta	Triangular-obtuse-(straight)	Rectangular-obtuse-convex	Striate	Trizonocolpate Obtus-triangular	-

Prunus Linn. in Northern Pakistan.

MATERIALS AND METHODS

Study location

This study was undertaken at the Department of Plant Sciences Quaid-I-Azam University Islamabad and Department of Plant Sciences, Wickson Hall University of California Davis USA. SEM was done on FEI-Phillips XL-30 S FEG SEM microscope in the Material Sciences Facility at Kemper Hall at the University of California Davis, USA. The plant samples were collected from the field in the Northern areas of Pakistan and from different Herbaria including Herbaria at Quaid-i-Azam University Islamabad, Pakistan Museum of Natural History, (PMNH), Islamabad, and John Tucker Herbarium at University of California Davis. Pakistan is located on the North Western side of South Asia. Its geographical extension lies between 24° and 37° north and longitude 61° and 78° east. The area of Pakistan is about 7, 93, 000 sq. km and it is the second largest nation in the South Asia, India being the largest (Bano et al., 1995). In the present study, the *Prunus* species were collected from the Northern parts of Pakistan namely Murree, Galiat, Abbottabad, and Manshera including *Prunus domestica* L*., Prunus avium* L*., Prunus persica* (L.) Batsch, *Prunus armeniaca* L*., Prunus bokhariensis Royle*, and *Prunus cornuta* (Wall. ex. Royle) Steudel.

Pollen morphological characterization

For the pollen morphological characterization different aspects of the pollens were studied including the shape, length, width, length and width ratio, number of colpi, arbitary distance between the ridges, arbitary distance between the furrows, width of ridges, width of furrows, presence or absence of spines and exine sculpturing in the polar and equatorial view.

SEM analysis

For SEM evaluation, properly dried pollens of each of the 6 species were placed on the double-sided transparent tape on the surface of the polished Aluminum stub. The samples on the aluminum stub were sputter coated with gold (Au) layer 225 A° thick (for two minutes in sputter). The pollen grains were studied in the FEI-Phillips XL-30 S FEG SEM Microscope at 5 KV and photographed between 1000 - 6279 x for the whole grain and at 10,000 x for the exine sculpturing patterns, respectively. The length and the width of the pollen grain along with length/width (L/W) ratio, distance between two ridges, width of ridge, distance between two furrows, width of furrow, length of equatorial ridge, distance between two colpi in the triangular pollen and the diameter of the colpi in the triangular pollen were measured. The measurements were made in micrometer (μm).

RESULTS

Palynology

The pollen class is trizonocolpate mostly elliptic trizono-colpate in the equatorial view and obtuse-triangular in the polar view. The pollen is tricolpate without spines. The shape of the pollens varies from triangular-acute-convex to triangular-obtuse-convex. *P. avium* has triangular-obtuse-convex-straight in the polar view while *P. cornuta* has triangular-obtuse-straight in the polar view (Table 1-3). The sculpturing of the exine is mostly striate (Figure 1).

P. bokhariensis Royle

Shape of pollen is triangular-obtuse-convex-circular inpolar view while the shape of pollen in equatorial view is elliptic-acuminate-acute. Pollen class is trizonocolpate-obtus-triangular (Figure 2B). Sculpturing of exine surface is striate. Number of colpi is three (that is tricolpate) while the spines are absent. The horizontal distance (width) is 25.13 ± 0.745 μm and the vertical distance (length) is 26.31 ± 0.849 μm. The length - width ratio in *P. bokhariensis* in the polar view is 1.04 μm. The arbitary distance between the ridges is 0.51 ± 0.008 μm and

Table 2. Pollens in the polar view (measurements in μm).

Species	Horizontal distance (length) (μm)	Vertical distance (width) (μm)	L/W ratio (μm)	OD. b/w two ridges (μm)	OD. b/w two furrows (μm)	Width of ridge (μm)	Width of furrow (μm)
Prunus avium	31.46 ±0.040 (31.4-31.54)	34.17±0.10 (34 - 34.36)	1.08	0.6±0.008 (0.59 - 0.62)	0.52±0.02 (0.49 - 0.57)	0.37±0.005 (0.36 - 0.38)	0.32±0.01 (0.3 - 0.35)
P. domestica	35.87 ±0.07 (35.78 - 36.08)	31.44 ±0.56 (30 - 32.46)	0.87	0.54±0.009 (0.52 - 0.56)	0.54±0.04 (0.4 - 0.62)	0.43±0.03 (0.39 - 0.52)	0.41±0.01 (0.39 - 0.45)
P. bokhariensis	25.137± 0.74 (23.08 - 26.27)	26.315±0.84 (23.79 - 27.47)	1.04	0.51±0.008 (0.5 - 0.54)	0.505±0.02 (0.48 - 0.57)	0.45±0.01 (0.4 - 0.48)	0.32±0.01 (0.3 - 0.37)
P. persica	50.14±0.39 (40 - 42.5)	37.66±0.42 (36.5 - 39.28)	0.66	0.51±0.03 (0.41 - 0.65)	0.62±0.04 (0.5 - 0.75)	0.46±0.02 (0.39 - 0.55)	0.43±0.01 (0.4 - 0.48)
P. armeniaca	35.29±0.32 (34.95 - 35.94)	36.17±0.19 (35.84 - 36.5)	1.00	0.35±0.01 (0.32 - 0.38)	0.47±0.01 (0.45 - 0.49)	0.35±0.02 (0.31 - 0.39)	0.22±0.01 (0.2 - 0.25)
P. cornuta	21.00 ±0.18 (20.6 - 21.5)	21.065 ±0.05 (20.95 - 21.2)	1.00	0.41 ±0.005 (0.4 - 0.42)	0.62 ±0.009 (0.6 - 0.64)	0.31 ±0.008 (0.3 - 0.33)	0.14 ±0.04 (0.17 - 0.2)

OD: Arbitary distance; L/W: length/width; b/w: between.

Table 3. Pollens in the equatorial view (measurements in μm).

Species	Horizontal distance (length) (μm)	Vertical distance (width) (μm)	L/W ratio (μm)	OD. b/w two ridges (μm)	OD. b/w two furrows (μm)	Width of ridge (μm)	Width of furrow (μm)
P. avium	29.94±0.66 (28 - 31.26)	26.73±0.43 (25.7 - 27.92)	0.89	0.58±0.01 (0.55 - 0.62)	0.51±0.01 (0.48 - 0.59)	0.34±0.02 (0.29 - 0.44)	0.24±0.006 0.22 - 0.26
P. domestica	36.25±0.13 (26.12 – 36.67)	32.15±0.62 (32.95 - 41.48)	0.88	0.77±0.11 (0.48 - 0.98)	0.63±0.04 (0.51 - 0.74)	0.41±0.01 (0.39 - 0.46)	0.38±0.01 (0.34 - 0.43)
P. bokhariensis	24.4±0.15 (24.1 - 24.62)	22.26±0.37 (21.55 - 22.84)	0.91	0.55±0.01 (0.53 - 0.59)	0.51±0.005 (0.5 - 0.52)	0.3±0.003 (0.3 - 0.31)	0.33±0.01 (0.31 - 0.36)
P. cornuta	25.99±0.84 (25.07 - 27.69)	13.53±0.07 (13.41 - 13.68)	0.52	0.43±0.01 (0.42 - 0.47)	0.56±0.01 (0.54 - 0.59)	0.34±0.006 (0.33 - 0.35)	0.31±0.008 (0.3 - 0.33)
P. persica	35.27±0.56 (34.3 - 36.7)	25.21±0.56 (21.61 - 26.55)	0.71	0.51±0.01 (0.49 - 0.56)	0.55±0.02 (0.5 - 0.59)	0.46±0.01 (0.43 - 0.49)	0.32±0.01 (0.3 - 0.35)
P. armeniaca	32.33±0.37 (31.46 - 33.15)	29.21±0.47 (28.23 - 29.1)	0.90	0.43±0.01 (0.41 - 0.46)	0.51±0.008 (0.5 - 0.54)	0.33±0.01 (0.31 - 0.36)	0.32±0.01 (0.28 - 0.36)

OD: Arbitary distance; L/W: length/width; b/w: between.

ranges between 0.5 - 0.54 μm and the arbitrary distance between the furrows is 0.50 ± 0.021 μm and ranges between 0.48 - 0.57 μm. The width of ridges is 0.45 ± 0.017 μm with ranges between 0.4 - 0.48 μm, while the width of furrow is 0.32 ± 0.016 (μm) with ranges between 0.3 - 0.37 μm. The length - width ratio in *P. bokhariensis* in the equatorial view is 0.91 μm. The arbitrary distance between the ridges is 0.55 ± 0.017 μm and ranges between (0.53 - 0.59 μm) and the distance between the furrows is 0.51 ± 0.005 μm ranging between 0.5 - 0.52 μm. The width of ridges is 0.3 ± 0.003 μm ranging between 0.3 - 0.31 μm, while the width of furrows is 0.33 ± 0.014 μm with ranges between 0.31 - 0.36 μm.

P. domestica L.

Shape of pollen is triangular-obtuse-convex in the polar view while the shape of pollen is elliptic-acuminate-acute in the equatorial view. Pollen class is trizonocolpate-obtus-triangular. The sculpturing of exine surface is striate. The number of colpi is three while the spines are absent (Figure 2A). The horizontal distance (width) in the polar view is 35.87 ± 0.072 μm and the vertical distance (length) in the polar view is 31.44 ± 0.566 μm. The length - width ratio in *P. domestica* in the polar view is 0.87 μm. The arbitrary distance between the ridges is 0.54 ± 0.009 μm with ranges between 0.52 - 0.56 μm, and the arbitrary
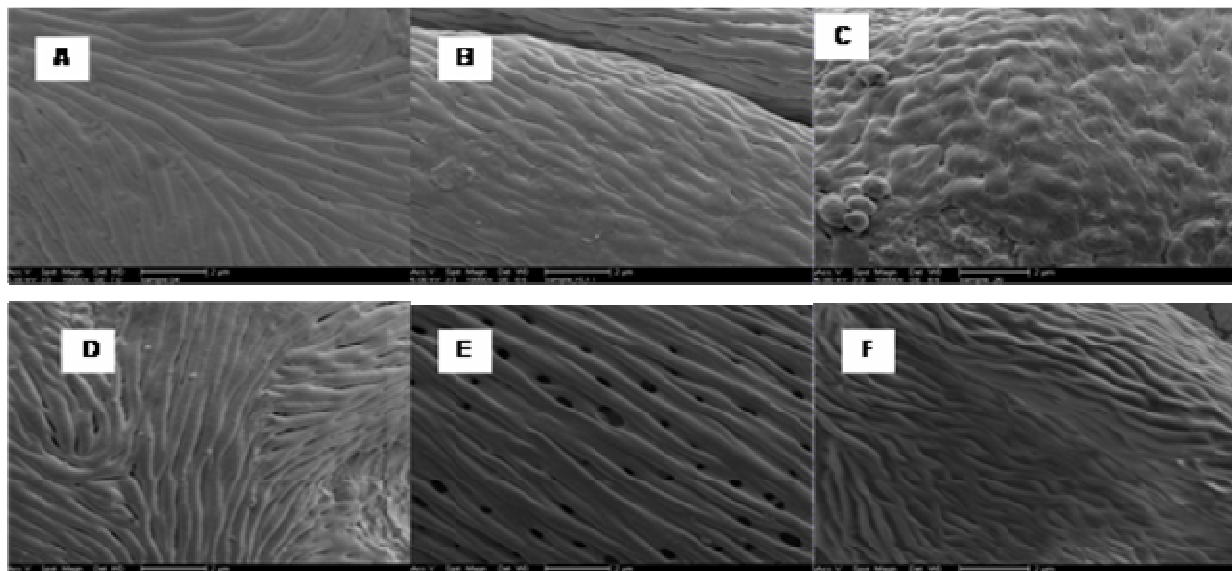
Figure 1. Exine sculpturing in *Prunus* species. **(A)** *P. domestica*, **(B)** *P. persica*, **(C)** *P. bokhariensis*, **(D)** *P. avium,* **(E)** *P. armeniaca* and **(F)** *P. cornuta* at 10,000 X for determining the exine sculpturing patterns.
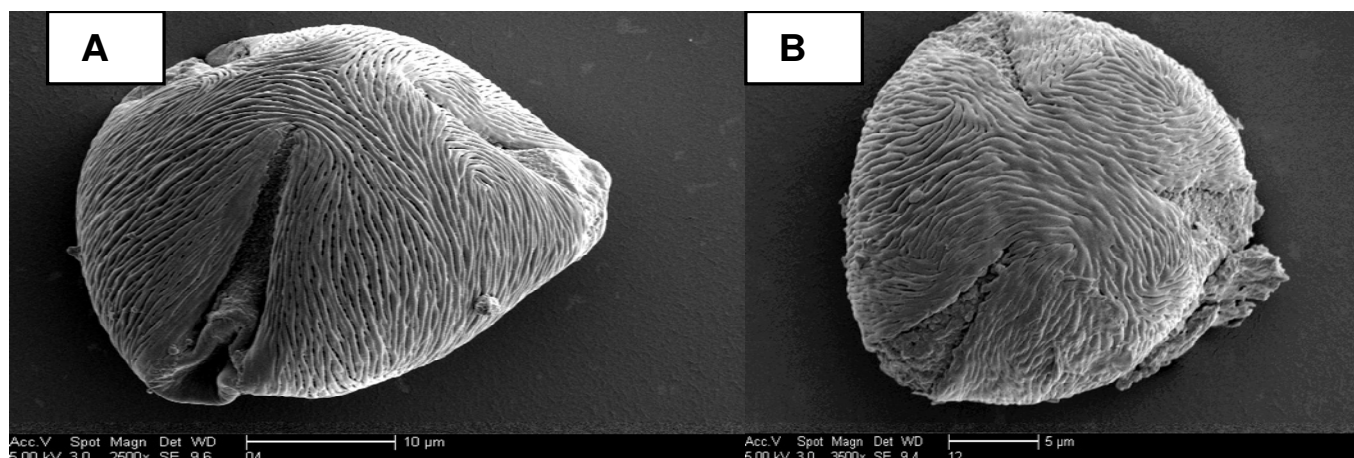

Figure 2. Scanning electron microphotograph polar view of **A.** *Prunus domestical* and **B.** *Prunus bokhariensis.*

distance between the furrows is 0.54 ± 0.009 μm ranging between 0.4 - 0.62 μm. The width of ridges is 0.43 ± 0.03 μm and ranges between 0.39 - 0.52 μm, while the width of furrow is 0.41 ± 0.012 μm with ranges between 0.39 - 0.45 μm. The horizontal distance (width) in the equatorial view is 36.25 ±0.136 μm while the vertical distance (length) in the equatorial view is 32.15 ± 0. 623μm. The length - width ration in the equatorial view is 0.88 μm. The arbitrary distance between the furrows is 0.63 ± 0.047 μm with ranges between 0.51 - 0.74 μm and the arbitrary distance between the ridges is 0.77 ±0.115 μm ranging between 0.48 - 0.98 μm. The width of furrow is 0.38 ± 0.016 μm with ranges between 0.34 - 0.43 μm while the width of ridge is 0.41 ± 0.012 μm ranging between (0.39 - 0.46 μm).

P. armeniaca L.

Shape of pollen is triangular-obtuse-convex in polar view, while the shape is elliptic-acuminate-acute in equatorial view. The sculpturing of exine surface is striate. The pollen class is trizonocolpate-obtus-triangular and the number of colpi is three (tricolpate). The spines are absent (Figure 3B). The horizontal distance (width) in the polar view is 35.29 ± 0.321 μm while the vertical distance (length) is 36.17 ± 0.190 μm. The length-width ratio in *P. armeniaca* in the polar view is 1.00. The arbitrary distance between the ridges is 0.35 ±0.017 μm with ranges between 0.32 - 0.38 μm and the arbitrary distance between the furrows is 0.47 (± 0.011 μm) ranging between 0.45 - 0.49 μm. The width of furrow is 0.22 ±
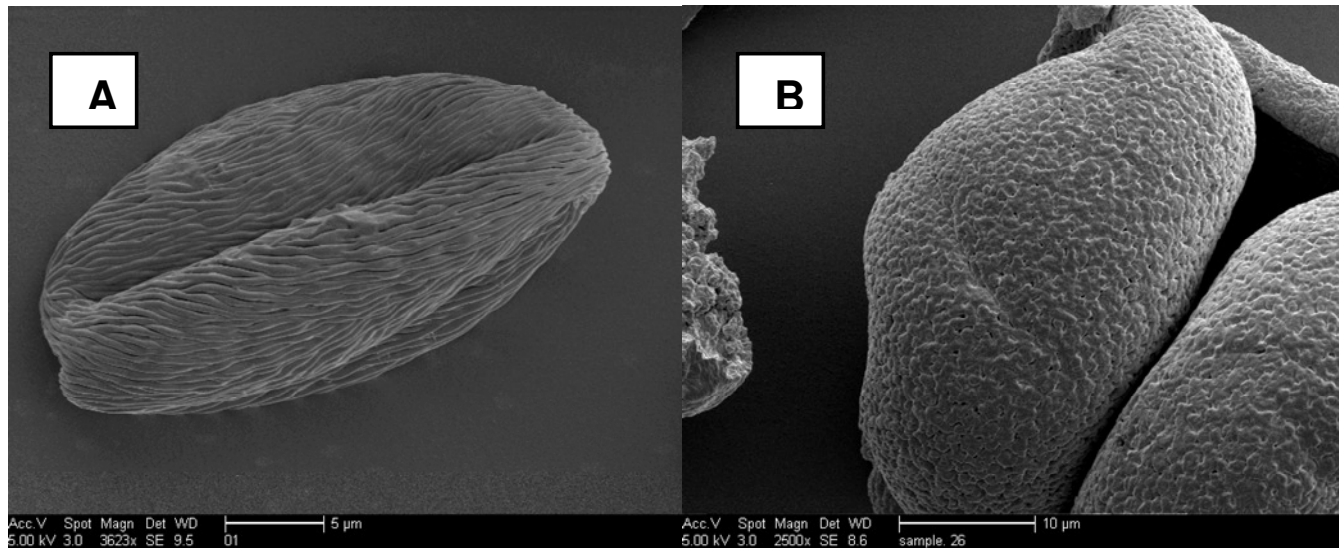
Figure 3. Scanning electron microphotograph equatorial view of A. *Prunus avium* and B*. Prunus armeniaca.*

0.014 μm and ranges between 0.2 - 0.25 μm while the width of ridges is 0.35 ± 0.023 μm and ranges between 0.31 - 0.39 μm. The horizontal distance (width) in the equatorial view is 32.33 ± 0.377 μm while the vertical distance (length) is 29.21 ± 0.471 μm. The length - width ratio in the equatorial view is 0.90. The arbitrary distance between the ridges is 0.43 ±0.011 μm with ranges between 0.41 - 0.46 μm and the arbitrary distance between the furrows is 0.51 ± 0.008 μm ranging between 0.5 - 0.54 μm. The width of furrow is 0.32 ± 0.019 μm and ranges between 0.28 - 0.36 μm while the width of ridge is 0.33 ± 0.011 μm and ranges between (0.31 - 0.36 μm).

P. avium L.

The shape of pollen in the polar view is triangular-obtuse-convex- (straight) polar view while the shape of pollen in the equatorial view is elliptic-acuminate-obtuse. The sculpturing of exine surface is striate. The pollen class is trizonocolpate-obtus-triangular. The number of colpi is three (tricolpate) while the spines are absent (Figure 3A). The horizontal distance (width) in the polar view is 31.46 ± 0.040 μm, while the vertical distance (length) is 34.17 ± 0.104 μm. The length - width ratio in *P. avium* in the polar view is 1.08 μm. The arbitrary distance between the ridges is 0.6 ±0.008 μm and ranges between 0.59 - 0.62 μm and the arbitrary distance between the furrows is 0.52 ± 0.025 with ranges between 0.49 - 0.57 μm. The width of furrow is 0.32 ± 0.015 μm and ranges between 0.3 - 0.35 μm while the width of ridges is 0.37 ± 0.005 μm and ranges between 0.36 - 0.38 μm. The horizontal distance (width) in the equatorial view is 29.94 ± 0.668 μm while the vertical distance (length) is 26.73 ± 0.432 μm. The length - width ratio in the equatorial view is 0.89 μm. The arbitrary distance between the ridges is 0.58 ± 0.012 μm

with ranges between 0.55 - 0.62 μm and the arbitrary distance between the furrows is 0.51 ± 0.019 μm ranging between 0.48 - 0.59 μm. The width of furrow is 0.24 ± 0.006 μm and ranges between 0.22 - 0.26 μm while the width of the ridges is 0.34 ± 0.025 μm and ranges between (0.29 - 0.44 μm).

P. persica (L.) Batsch

The shape of pollen is triangular-obtuse-convex in the polar view while the shape of pollen is elliptic-obtuse-convex- (circular) in the equatorial view. The pollen class is trizonocolpate-obtus-triangular while the sculpturing of exine surface is striate. The number of colpi is three (tricolpate) while the spines are absent (Figure 4A). The horizontal distance (width) in the polar view is 41.31 ± 0.393 μm while the vertical distance (length) is 27.66 ± 0.421 μm. The length - width ratio in *P. persica* in the polar view is 0.66μm. The arbitrary distance between the ridges is 0.51 ±0.037 μm ranging between 0.41 - 0.65 μm and the arbitrary distance between the furrows is 0.62 ± 0.04 μm with ranges between 0.5 - 0.75 μm. The width of furrow is 0.43 ± 0.014 μm and ranges between 0.4 - 0.48 μm while the width of ridges is 0.46 ± 0.027 μm and ranges between (0.39 - 0.55 μm). The horizontal distance (width) in the equatorial view is 35.27 ± 0.566 μm while the vertical distance (length) is 25.21 ± 0.565 μm. The length – width ratio in the equatorial view is 0.71 μm. The arbitrary distance between the ridges is 0.51 ±0.016 and ranges between 0.49 - 0.56 μm and the arbitrary distance between the furrows is 0.55 ± 0.020 μm and ranges between 0.5 - 0.59 μm. The width of furrow is 0.32 ± 0.011 μm with ranges between 0.3 - 0.35 μm while the width of ridges is 0.46 ± 0.012 μm and ranges between 0.43 - 0.49 μm.
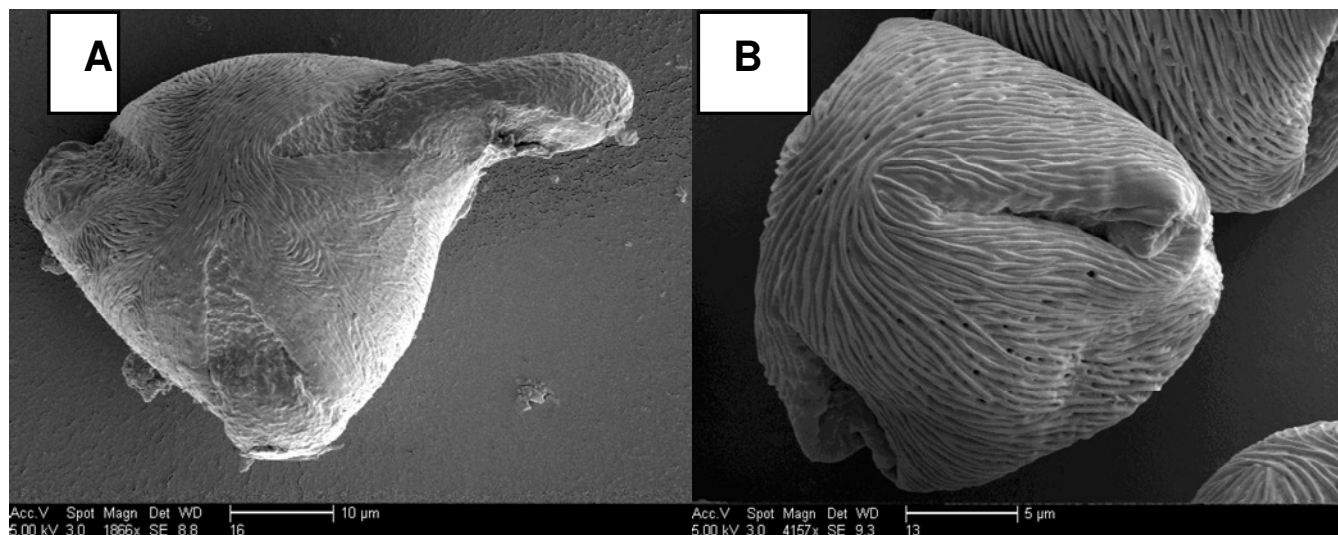
Figure 4. Scanning electron microphotograph polar view of A. *Prunus persica* and B. *Prunus cornuta.*

P. cornuta (Wall. ex. Royle) steudel

The shape of pollen is triangular-obtuse- (straight) in the polar view while the shape of pollen is rectangular-obtuse-convex in equatorial view. The pollen class is trizonocolpate-obtus-triangular while the sculpturing of exine surface is striate. The number of colpi is three (tricolpate) while the spines are absent (Figure 4B). The horizontal distance (width) in the polar view is 21.00 ± 0.185 µm while the vertical distance (length) is 21.065 ± 0.056 µm. The length – width ratio in *P. cornuta* in the polar view is 1.00 µm. The arbitrary distance between the ridges is 0.41 ±0.005 µm with ranges between 0.4 - 0.42 µm and the arbitrary distance between the furrows is 0.62 ± 0.009 µm with ranges between 0.6 - 0.64 µm. The width of furrow is 0.14 ± 0.047 µm and ranges between 0.17 - 0.2 µm while the width of the ridges is 0.31 ± 0.008 µm and ranges between 0.3 - 0.33 µm. The horizontal distance (width) in the equatorial view is 25.99 ± 0. 849 µm while the vertical distance (length) is 13.53 ± 0.078 µm. The length – width ratio in the equatorial view is 0.52 µm. The arbitrary distance between the ridges is 0.43 ±0.016 µm ranging between 0.42 - 0.47 µm and the arbitrary distance between the furrows is 0.56 ± 0.014 µm ranging between 0.54 - 0.59 µm. The width of furrow is 0.31 ± 0.008 µm and ranges between 0.3 - 0.33 µm while the width of ridges is 0.34 ± 0.006 µm and ranges between (0.33 - 0.35 µm).

DISCUSSION

The *Prunus* species were collected from the Northern parts of Pakistan. The species included the main species that are being domesticated for fruits and commercial purposes and species growing in the wild including *P.* armeniaca, P. avium, P. bokhariensis, P. domestica, P. persica and *P. cornuta* which is the only specie not domesticated and fruit is not edible, the other species have the edible fruit and are domesticated. There is a lot of variation in the pollen morphological characterization. The main aspect studied were the shape of pollen in the polar and equatorial view, horizontal distance (width), vertical distance (length) in the polar and equatorial view, length / width ratio, arbitrary distance between the ridges, arbitrary distance between the furrows in the polar and equatorial view, width of ridges, width of furrows in the polar and equatorial view, sculpturing of the exine surface, number of colpi, presence or absence of spines, and presence or absence of pores. Arazani et al. (2005) discussed the shapes and morphological characterization of *P. armeniaca* through scanning electron microscopy and explained the pollen grain shape in two groups according to their shape, that is, elliptic trizonocolpate and obtuse-triangular.

The morpho-physiological observations on pollen of *P. cerasus* cultivars was done by Miaja et al. (1998) who also studied the pollen structure of the different cultivars of *P. cerasus* using SEM for the morpho-physiological observations and so the shape of pollen can give a better idea in differentiating different cultivars and also among different species. The pollen morphology of the *Prunus* has mostly trizonocolpate to elliptic trizonocolpate shape common in the equatorial view and obtuse-triangular in the polar view. The pollen is tricolpate without spines. Under these two shapes, there is a variation regarding the shape of colpi in the outline and the variation within the trizonocolpate and obtuse triangular shapes of pollen in the polar and equatorial view. The sculpturing of the exine is striate among all these species. Youshihiro and Hiroaki (1989) discussed the morphometric analysis of pollen exine patterns in roses from family *Rosaceae*

through scanning electron microscopy and described the pollens as tricolpate as found in *Prunus* and the exine sculpturing also striate as already discussed. The pollen class is trizonocolpate, mostly elliptic trizonocolpate in the equatorial view and obtuse-triangular in the polar view. The pollen is tricolpate without spines. The shape of the pollens varies from triangular-acute-convex to triangular-obtuse-convex. *P. avium* has the triangular-obtuse-convex-straight shape in the polar view while *P. cornuta* has triangular-obtuse-straight in the polar view. The sculpturing of the exine is mostly striate. The pollens shape varies in the different species of *Prunus* in the polar and equatorial view. In *P. bokhariensis* the shape of pollen in polar view is triangular - obtuse - convex - circular. The shape of pollen in the equatorial view is elliptic - acuminate - acute, the sculpturing of exine is striate. The pollen class is trizonocolpate - obtuse - triangular and the pollen is tricolpate. The shape of pollen of *P. domestica* in polar view is triangular - obtuse - convex. The shape of pollen of *P. domestica* in equatorial view is elliptic - acuminate - acute. The sculpturing of exine is striate and the pollen class is trizonocolpate-obtuse-triangular. In the present study, the shape of pollen in *P. armeniaca* in the polar view is triangular - obtuse - convex and the shape of pollen in the equatorial view is elliptic - acuminate - acute. The sculpturing of the exine is striate. The pollen class is trizonocolpate - obtuse - triangular. The shape of pollen in *P. avium* is triangular - obtuse - convex - (straight) in the polar view, while the shape in the equatorial view is elliptic - acuminate - obtuse. The sculpturing of exine is striate. The pollen class is trizonocolpate - obtuse - triangular. The shape of pollen in *P. persica* is triangular - obtuse - convex, and the shape of pollen in the equatorial view is elliptic - obtuse - convex - circular. The sculpturing of exine is striate. The pollen class is trizonocolpate - obtuse - triangular. The shape of pollen in *P. cornuta* in the polar view is triangular - obtuse - (straight), and the shape of pollen in the equatorial view is rectangular - obtuse - convex. The sculpturing of exine is striate. The pollen class is trizonocolpate - obtuse - triangular.

The maximum length in the equatorial view is 36.25 ± 0.13 µm found in *P. domestica* and the minimum length is 24.4 ± 0.15 µm found in *P. bokhariensis* in the equatorial view. The maximum width is 32.15 ± 0.62 µm in *P. domestica* and the minimum width is 13.53 ± 0.07 µm in *P. cornuta* in the equatorial view. The maximum length width ratio is 0.91 µm found in *P. bokhariensis* and the minimum length width ratio is 0.52 µm found in *P. cornuta* in the equatorial view. The maximum length in the polar view is 50.14 ± 0.39 µm found in *P. persica* while the minimum length is 21.00 ± 0.18 µm found in *P. cornuta* in the polar view. The maximum width is 37.66 ± 0.42 µm while the minimum width is 21.065 ± 0.05 µm found in *P. cornuta* in the polar view. The maximum length width ratio is 1.08 µm found n *P. avium* and the minimum ratio is 0.66 µm found in *P. persica* in the polar view. The maximum arbitary distance between the furrows in the

equatorial view was 0.77 ± 0.11 µm found in *P. domestica* and the minimum distance was 0.43 ± 0.01 µm found both in *P. armeniaca* and *P. cornuta*. The maximum arbitary distance between the furrows in the polar view was 0.6 ± 0.008 µm found in *P. avium* and the minimum distance was 0.35 ± 0.01 µm found in *P. armeniaca*. The maximum arbitary distance between the ridges in the equatorial view was 0.63 ± 0.04 µm found in *P. domestica* and the minimum distance was 0.51 ± 0.01 µm found in *P. avium, P. bokhariensis* and *P. armeniaca*. The maximum arbitary distance between the ridges in the polar view was 0.62 ± 0.04 µm found in *P. persica* and *P. cornuta* while the minimum distance was 0.47 ± 0.01 µm found in *P. armeniaca*. The maximum width of ridge in the equatorial view was 0.46 ± 0.01 µm found in *P. persica* while the minimum width was 0.3 ± 0.003 µm found in *P. bokhariensis*. The maximum width of ridge in the polar view was 0.46 ± 0.02 µm found in *P. persica* while the minimum width was 0.31 ± 0.008 µm found in *P. cornuta*. The maximum width of furrow in the equatorial view was 0.38 ± 0.01 µm found in *P. domestica* while the minimum width was 0.31 ± 0.008 µm found in *P. cornuta*. The maximum width of furrow in the polar view was 0.43 ± 0.01 µm found in *P. persica* while the minimum width was 0.14 ± 0.04 µm found in *P. cornuta*. The overall results showed that the species discussed here belong to a single genus *Prunus* having many similar characters and a few variations.

Conclusion

The results suggests that overall, the pollen class of the *Prunus* species discussed here belongs to trizonocolpate mostly elliptic trizonocolpate in the equatorial view and obtuse-triangular in the polar view. The pollen is tricolpate without spines. The shape of the pollens varies from triangular-acute-convex to triangular-obtuse-convex. The sculpturing of the exine is striate among these species. The common characters suggest that all these species are under a single genus *Prunus* and not to split the species into different genera other than *Prunus.*

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