

SEED MORPHOLOGY OF THE GENUS *SILENE*: CARYOPHYLLACEAE FROM PAKISTAN AND KASHMIR

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ABSTRACT

Seed morphology of fifteen species of the genus *Silene*: Caryophyllaceae has been examined by light and scanning microscope. Viz., *Silene arenosa* C.Koch, *Silene brahuica* Boiss., *Silene citrina* Boiss., *Silene coeli-rosea* (L.) Gordon, *Silene conoidea* L., *Silene falconeriana* Benth., *Silene gonosperma* (Rupr.) Bocquet, *Silene indica* Roxb. ex Oth., *Silene longisepala* E. Nasir, *Silene moorcroftiana* Wall ex Benth, *Silene pseudo-verticillata* E. Nasir, *Silene staintonii* S.A.Ghazanfer, *Silene tenuis* Willd., *Silene viscosa* (L.) pers., and *Silene vulgaris* (Moech) Garcke.

Seed generally small-medium, 0.3 -2.0 mm long, light-dark brown, black, light green or greyish green in colour. Shape mostly reniform or orbicular, rarely pyriform, mostly laterally compressed, hilum distinct, surface generally striate with distinct groove in between striae, striae broad-elongated, finely scabrate, mostly without tubercule rarely tuberculated. On the basis of surface pattern 16 species are divided into two seed types. Viz., Type-I: *Silene arenosa* and Type-II: *Silene longisepala*. Key is prepared based on Seed morphological characters. Seed morphology of the genus *Silene* is significantly helpful at the specific level.

Key-words: Seed morphology, *Silene*, Caryophyllaceae, Kashmir, Pakistan.

INTRODUCTION

Silene is a large complex polymorphic genus belongs to the family Caryophyllaceae representing about 600 species in the temperate regions of the world (Kubitzki, 2002a,b). The main concentration of the species is in Europe, Asia and North Africa. In Pakistan 28 species are found, most of which are central Asiatic or Himalayan in their affinities. The perennials are usually found in the mountain areas and annuals in the plains, often weedy (Ghazanfar & Nasir, 1986). Plant are annual or perennial herbs with ascending to decumbent or erect stems. Leaves radical and cauline, of varied shape Flower solitary or in raceme. Fruit capsule (Bittrich, 1994).

Seed morphology plays an important role in the taxonomic delimitation, but the seed morphological studies have completely been neglected in Pakistan. However, a number of studies have been conducted particularly from ecological or physiological point of view like seed germination or seedling establishment but this data had hardly used for taxonomic purposes. Ali (1968) seems to be the first person who has correlated the seed weight with the breeding system of closely related amphimictic taxa. Qaiser (1987) utilized the data of seed morphology in the family Tamaricaceae. He has shown for the first time that there is a direct correlation in the seed morphology and infrageneric classification particularly in the genus *Tamarix* several micromorphological characters were pointed out which served as additional character in this intricate family. Several species were also delimited on the basis of seed morphological studies. Ahmed & Qaiser (1990) studied 78 taxa belonging to different families from Karachi and its neighborhood. Omer and Qaiser (1995) examined seed morphology of the genus *Gentiana* L. (s.l.) from Pakistan and Kashmir. However, Yildiz and Cirpici (1998) studied seed morphology of the genus *Silene* L. from Turkey. Dinter & Greuter, (2004) studied the seed of *Silene rothmaleri*.

Yildiz (2006) examined morphological and Palynological characters of two species of the genus *Silene* i.e., the *Silene gigantea* L. var. *gigantea* and *Silene behen* L. (Caryophyllaceae) distributed in Western Anatolia and Northern Cyprus.

Seed characters have proved to be of a high systematic importance, and should be considered in any general study. The treatments are useful not only to plant taxonomists, but also to archaeologists, palaeobotanists, quaternary geologists, and ecologists

There are no reports on seed morphology of *Silene*: Caryophyllaceae from Pakistan. Present investigations are based on the seed morphology of 15 species of the genus *Silene* L. by light and scanning electron microscope.

MATERIALES AND METHODS

Collection of material: Seed samples were obtained from Karachi University Herbarium (KUH) or from the field.

For light microscopy: The seed Color of seeds, weight of seed, size of seed, texture of seeds were examined and observations were made with a Nikon Type-2 microscope under (E40, 0.65) and oil immersion (E100, 1.25), using 10x eye piece.

For Scanning Electron microscopy: SEM studies, Seeds were mounted on a metallic stub using double sided cellotape and coated with gold in a sputtering chamber (Ion sputter JFC-1100). Coating was restricted to 150A. The S.E.M examination was carried out on a Jeol microscope JSM-6380A. The measurements are based on 15-20 readings from each specimen. Seed size, shape, colour were examined. Micro-photographs were taken of each species.

RESULTS AND OBSERVATIONS

General seed morphology of the genus *Silene*

Seed small-medium, 0.3 -2.0 mm long, light-dark brown, black, light green or greyish green in colour. Shape mostly reniform or orbicular, rarely pyriform, mostly laterally compressed, hilum distinct, surface generally striate with distinct grooved in between striae, striae broad-elongated, finely scabrate, mostly without tubercule rarely tuberculated. Seed morphology is significantly helpful at the specific level.

Key to the species or species groups

1. + Seed winged.....*Silene gonosperma*
- Seed without winged.....2
2. + Seed 0.3-0.5 mm long.....3
- Seed < than 0.5 mm long.....5
3. + Seed 0.3mm long..... *Silene arenosa*
- Seed 0.5 mm long.....4
4. + seed surface tuberculate.....*Silene staintonii*
- Seed surface without tubercule.....*Silene coeli-rosea*
5. + Seed surface with narrow tubercule..... *Silene brahuica*
- Seed not as above.....6
6. + Seed surface striate with distinct grooved.....9
- Seed not as above.....7
7. + Surface rough reticulate..... *Silene longisepala*
- Surface not as above.....8
8. + Seed 2 mm long.....*Silene conoidea*
- Seed 1.5 mm long.....*Silene tenuis*
9. + Striae elongated.....10
- Striae broad.....11
10. Seed surface without tubercule.....*Silene pseudo-verticillata*
- Seed surface with tubercule.....*Silene falconeriana*
11. + Seed black in colour..... *Silene valgarius*
- Seed not as above.....12
- 12 + Seed surface perforated inbetween striae.....*Silene indica*
- Seed surface not perforated in between striae ...13
13. + Seed 1.5 mm long.....*Silene citrina*
- Seed 1-1.2 mm long.....14
14. + Seed greyish.....*Silene moorcroftiana*
- Blackish brown.....*Silene viscosa*

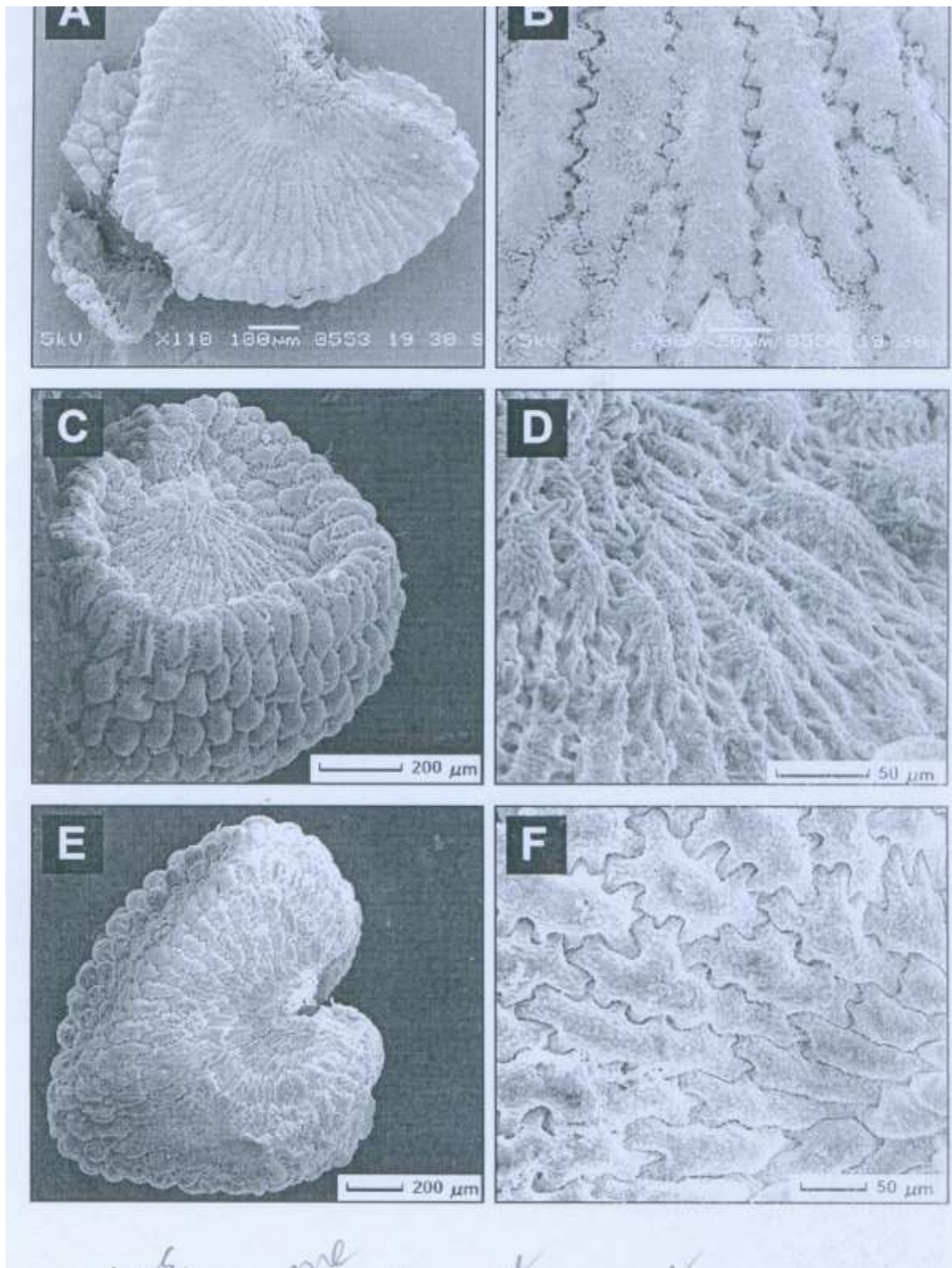


Fig.1. Scanning micrograph of *Silene arenas*: A, Seed; B, Seed surface; *Silene brahuica*: C, Seed; D, Seed surface; *Silene citrian*: E, Seed; F, Seed surface.

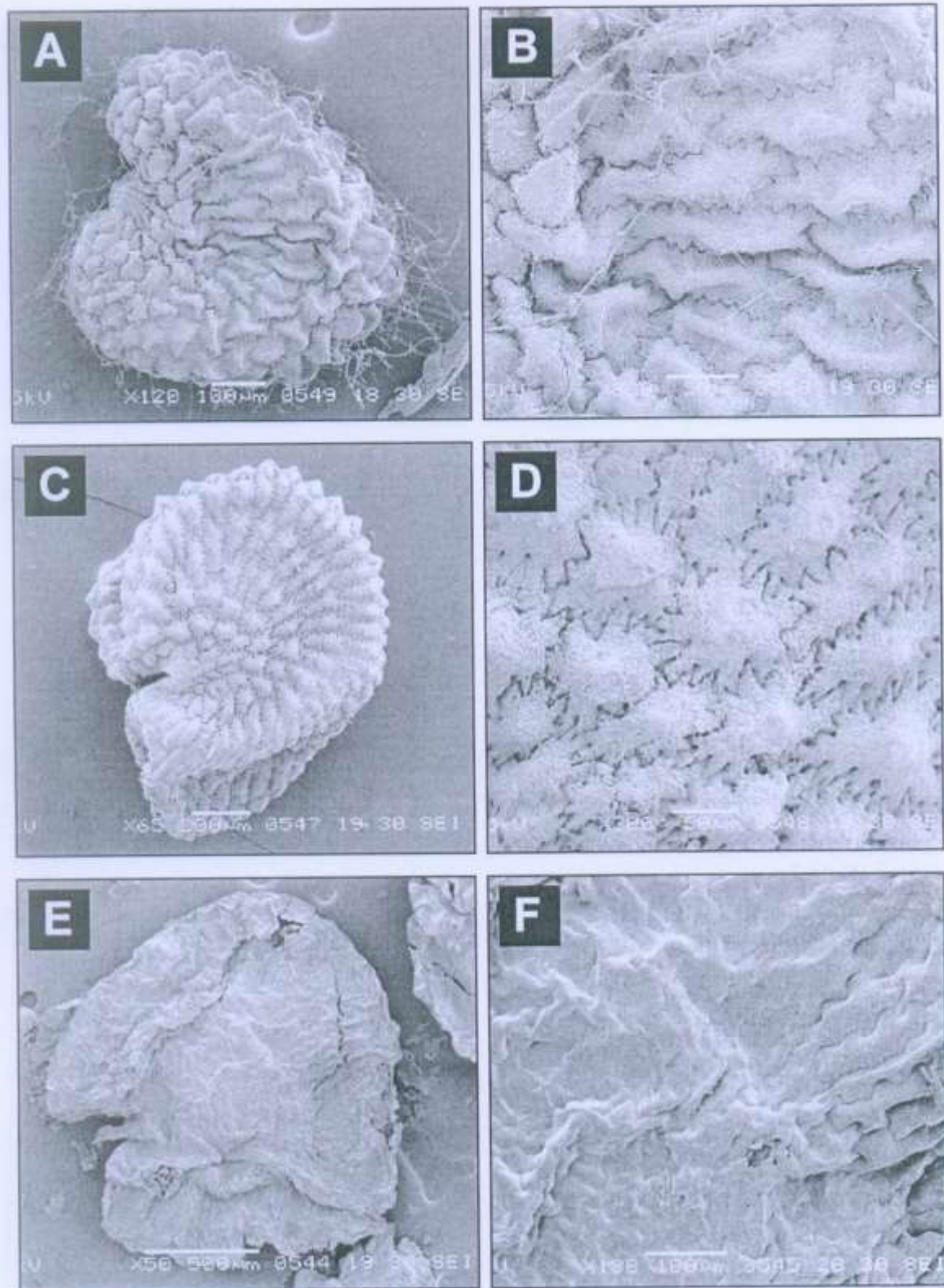


Fig.2. Scanning micrograph of *Silene coeli-rosea*: A, Seed; B, Seed surface; *Silene conoidea*: C, Seed; D, Seed surface; *Silene gonosperma*: E, Seed; F, Seed surface.

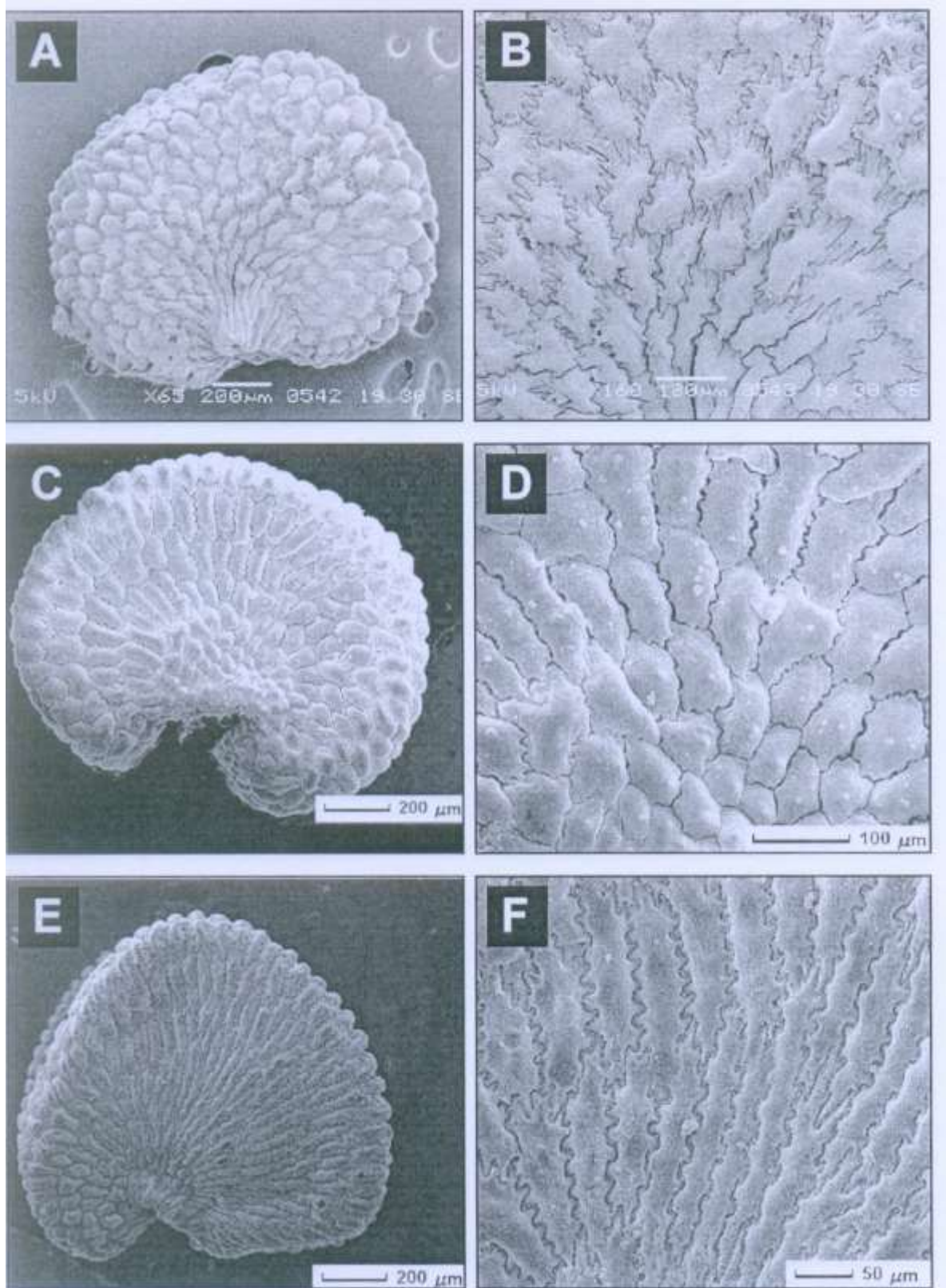


Fig.3. Scanning micrograph of *Silene indica*: A, Seed; B, Seed surface; *Silene moorcroftiana*: C, Seed; D, Seed surface; *Silene verticellata*: E, Seed; F, Seed surface.

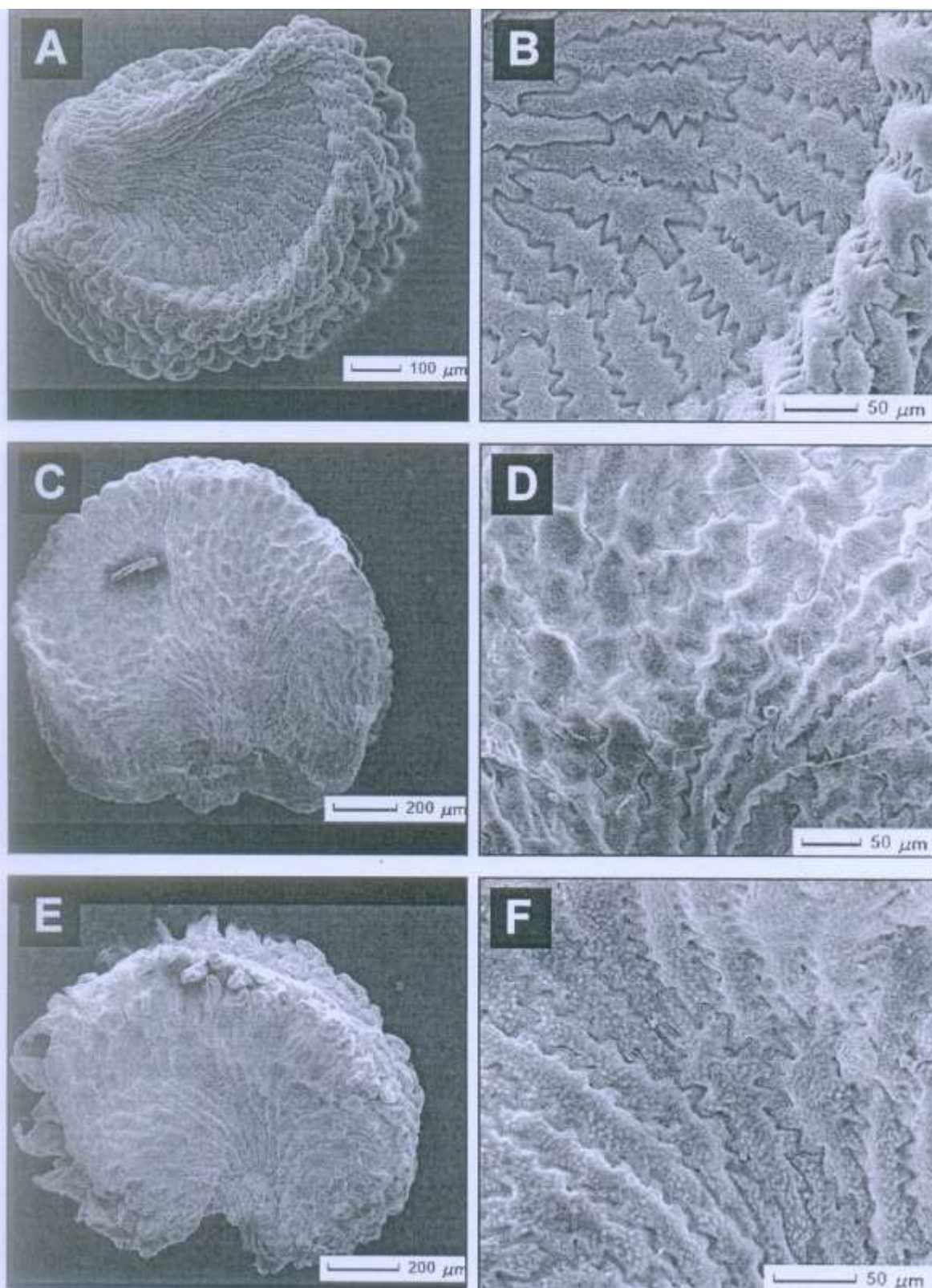


Fig.4. Scanning micrograph of *Silene staintoni*: A, Seed; B, Seed surface; *Silene tenuis*: C, Seed; D, Seed surface; *Silene viscosa*: E, Seed; F, Seed surface.

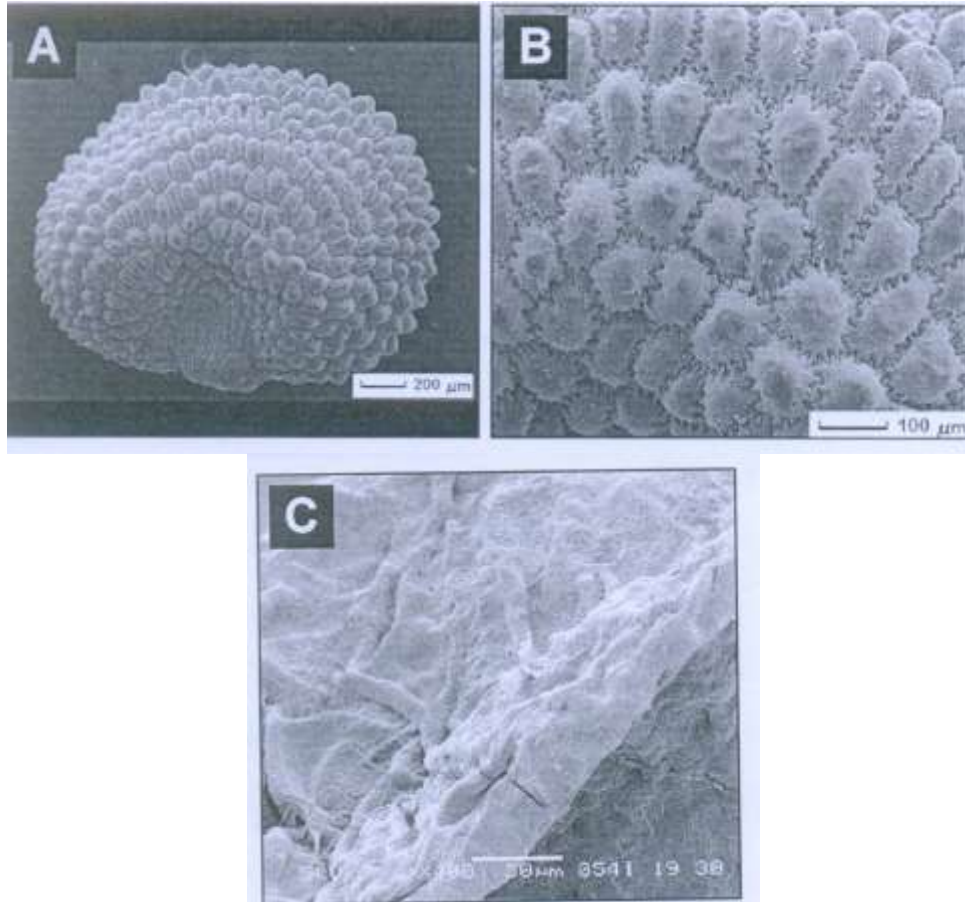


Fig.5. Scanning micrograph of *Silene vulgaris*: A, Seed; B, Seed surface; *Silene longisepala*: C.

1. *Silene arenosa* C.Koch (Fig.1A & B).

Small, 0.3 mm, yellow brown, reniform, laterally compressed, hilum distinct, surface broadly striate with distinct grooved in between the striae, finely scabrate.

2. *Silene brahuica* Boiss.(Fig.1 C & D).

Small, 0.9 mm, dark brown, orbicular, laterally compressed, hilum distinct, surface striate with distinct grooved in between, striae elongated, finely scabrate with distinct narrow tubercule.

3. *Silene citrina* Boiss.(Fig.1 E & F).

Small, 1.5 mm, greyish black, orbicular, laterally compressed, hilum distinct, surface broadly striate with distinct grooved in between the striae, finely scabrate, without tubercule.

4. *Silene coeli-rosea* (L.) Gordon (Fig.2 A & B).

Small, 0.5 mm, light brown, reniform, laterally compressed, hilum distinct, surface broadly striate with distinct grooved in between the striae, finely scabrate.

5. *Silene conoidea* L. (Fig.2 C & D).

Medium, 2mm, brown, orbicular, hilum distinct, surface rough striate –scabrate without tubercule.

6. *Silene falconeriana* Benth. (Fig.2. E & F).

Medium, 1.1 mm black, reniform, hilum distinct, surface striate, elongated, grooved in between the striae, tuberculate.

7. *Silene gonosperma* (Rupr.) Bocquet (Fig.2. E & F).

Medium, yellow brown to dark brown, winged, orbicular, laterally compressed, variable in breadth, 0.8-15 mm, hilum distinct, rough reticulate.

8. *Silene indica* Roxb. ex Oth. (Fig. 3A & B).

Small, c. 1.1 mm, greyish brown, long reniform,-orbicular, hilum distinct, surface broadly striate with distinct grooved in between the striae, striate perforate at the base, finely scabrate.

9. *Silene longisepala* E. Nasir (Fig.5 C).

Medium, 1.5 mm, light green, orbicular, laterally compressed, hilum distinct, surface rough reticulate., without tubercule.

10. *Silene moorcroftiana* Wall. ex Benth. (Fig.3 C & D).

Small, 1.1 mm, grey-green, orbicular-reniform, hilum distinct, surface broadly striate with distinct grooved in between the striae, finely scabrate.

11. *Silene pseudo-verticillata* E. Nasir (Fig.3E & F).

Small, 1.1 mm, black, reniform, hilum distinct, surface long striate with distinct grooved in between the striae, finely scabrate.

12. *Silene staintonii* S.A.Ghazanfer (Fig.4 A & B).

Small, 0.5 mm, dark brown, pyriform-reniform, laterally compressed, hilum distinct, surface elongated striate with distinct grooved in between the striae, finely scabrate, indistinct tubercule at the side of seed surface.

13. *Silene tenuis* Willd. (Fig.4 C & D).

Medium, 1.5 mm, black, orbicular, hilum distinct, surface striate-reticulate with distinct ridges striae finely scabrate without tubercule..

14. *Silene viscosa* (L.) pers. (Fig.4 E & F).

Small, 1.0 mm, black-brown, orbicular-reniform, laterally compressed, hilum distinct, surface broadly striate with distinct groove in between the striae, finely scabrate.

15. *Silene vulgaris* (Moech) Garcke (Fig.5 A & B).

Small, 1.1mm, black, orbicular, laterally compressed, hilum distinct, surface tuberculated with distinct groove in between tuberculi, finely scabrate.

DISCUSSION

The seed morphological studies is one of the important sources of taxonomic evidence. It will be helpful for taxonomist, paleoethnobotanists, archaeologists, ethnobotanists, as well as agro-technologists. Seed as a whole bear numerous morphological characters, which can be used for taxonomic purposes. Davis and Heywood (1963) emphasized upon the use of seed characters as these are reliable and constant within a taxa. The advanced families usually have complex seed types. Seed morphology play an important role in systematic and is helpful in the delimiting of many taxa (Duke 1965, Corner, 1976). Recently the technique of scanning Electron microscope has been widely used for the study of seed surface (Gutterman, 1973). Nasir (1985, 1986) studied the seed morphology of the genera *Androsace* and *Primula* respectively and observed numbers of characters with reference to taxonomy. During the present studies seed morphology of 15 species has been examined by scanning electron microscope. viz., *Silene arenosa* C.Koch, *Silene brahuica* Boiss., *Silene citrina* Boiss., *Silene coeli-rosea* (L.) Gordon, *Silene conoidea* L., *Silene falconeriana* Benth., *Silene gonosperma* (Rupr.) Bocquet, *Silene indica* Roxb. ex Oth., *Silene longisepala* E. Nasir, *Silene moorcroftiana* Wall ex Benth, *Silene pseudo-verticillata* E. Nasir, *Silene staintonii* S.A.Ghazanfer *Silene*, *Silene tenuis* Willd., *Silene viscosa* (L.) pers., and *Silene vulgaris* (Moech) Garcke. Seed morphology of the genus *Silene* is significantly useful at the specific level.

Seeds are generally small or very small (0.3-2mm long) black, Brown or nearly greyish-green, reniform, orbicular rarely pyriform, mostly laterally compressed less often dorsiventral compressed with a facial hilum or rarely winged (as in *Silene gonosperma*).

According to Stace (1980) seed are of particularly significant in families such as the Caryophyllaceae (*Dianthus*, *Petrorhagia*, *Stellaria*, *Spergularia*, *Spergula* and *Silene*).

In the present study shape of the seed varies from reniform-orbicular rarely pyriform in *Silene staintonii* S. A. Ghanzafer, or sometimes orbicular to reniform in *Silene moorcroftiana* Wall ex Benth, *Silene nana* Kar. & Kir. and *Silene viscosa* (L.) pers., However, majority of the species have reniform shape. Yildiz (2001, 2002, 2006) also reported reniform or orbicular-reniform seed in the genus *Silene*.

Similarly, size of the seed also varies from 0.3-2 mm long. However most of the species have 1.1 mm long seed., less frequent 0.3 seed found in *Silene arenosa* C.Koch and 0.5 mm long in *Silene staintonii* and *Silene coeli-rosea* (L.) Gordan. Seed surface also plays an important role in the identification of the closely related taxa. In the genus *Helotropium* various species could be delimited on the basis of different types of seed surface (Ahmed & Qaiser, 1990).

In the studied taxa seed surface mostly striate with distinct grooved in between the striae, striae broad or elongated. Less common rough surface also found in *Silene longisepala*. In few species tubercle also found on striae as in *Silene brahuica*. Boiss.

On the basis of surface pattern 15 species are divided into two seed types. Viz., Type-I: *Silene arenosa* and Type-II: *Silene longisephala*

Silene arenosa C.Koch, *Silene brahuica* Boiss., *Silene citrina* Boiss., *Silene coeli-rosea* (L.) Gordon, *Silene falconeriana* Benth., *Silene gonosperma* (Rupr.) Bocquet, *Silene indica* Roxb. ex Oth., *Silene moocroftiana* Wall ex Benth., *Silene nana* Kar. Kir, *Silene pseudo-verticillata* E. Nasir, *Silene staintonii* S.A.Ghazanfer *Silene*, *Silene tenuis* Willd., *Silene viscosa* (L.) pers., and *Silene vulgaris* (Moech) Garcke. are easily delimited on the basis striate seed pattern with distinct groove in between the striae. Type-II, is easily recognized by having rough striate-reticulate seed pattern. Only a single species is included in this type i.e., *Silene longisephala* E. Nasir.

Seed morphology of the genus *Silene* is significantly useful at the specific level.

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