

## THE SEED ATLAS OF PAKISTAN-III. CUSCUTACEAE

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### Abstract

Seed morphology of 8 species of the genus *Cuscuta* belonging to the family Cuscutaceae was examined using light and scanning electron microscopy. Seed morphological characters have been found useful to delimit the taxa at specific level and to design Seed Atlas of Pakistan.

### Introduction

Cuscutaceae is a parasitic family which includes a single genus *Cuscuta* L., with c. 145 species (Mabberley, 2008). It is cosmopolitan in distribution. In Pakistan it is represented by 14 species (Rajput & Tahir, 1988). Previously the genus *Cuscuta* was treated under the family Convolvulaceae and later on it was placed in the separate family Cuscutaceae (Takhtajan, 1969; Cronquist, 1981; Dahlgren, 1989). Seed morphology has played a key role in the taxonomy of this family (Corner, 1976; Ahmed & Qaiser, 1989; Fang *et al.*, 1995; Costea *et al.*, 2005; Kirkbride *et al.*, 2006; Bojnansky & Fargasova, 2007). However, Jian-Zhong *et al.*, (1993) examined the surface ultra structure of seeds to delimit the various species of *Cuscuta* from China. Present report is a part of "Seed Atlas of Pakistan" in which 8 species of the genus *Cuscuta* were examined for their seed morphology from Pakistan.

### Materials and Methods

Mature and healthy seeds of 8 species belonging to the genus *Cuscuta* of the family Cuscutaceae were collected from herbarium specimens (Appendix I.) and seed morphological characters were examined under light microscope (Nikon Type 102) and scanning electron microscope (JSM-6380A). For scanning electron microscopy dry seeds were directly mounted on metallic stubs using double adhesive tape and coated with gold for a period of 6 minutes in a sputtering chamber and observed under SEM. The terminology used is in accordance of Bergreen (1981) and Stearn (1983) with slight modifications. The characters of seed studied were size, colour, shape, surface (testa) and position of hilum.

**General seed characters of the family Cuscutaceae:** Seeds 1-4.5 x 0.5-3 mm, angular or non-angular, globose, triangular obovate, sub-cuneate, sub-reniform or elliptic pyriform, light brown, dark brown, golden brown or black, shiny or unshiny, surface alveolate, foveate, striate, rugose, ruminately foveate, rugosely foveate or reticulately foveate, hilum indistinct or distinct, basal, sub basal or sub-central in position (Table 1; Figs. 1-2).

Following 8 species examined are *Cuscuta campestris* Yucnk., *C. europaea* L., *C. gigantea* Griff., *C. hyalina* Roth, *C. lehmanniana* Bunge, *C. monogyna* Vahl, *C. pulchella* Engelm., and *C. reflexa* Roxb.

Table 1. Seed morphological characters of the family Cuscutaceae.

Name of taxa	Size (mm)	Colour	Shape	Surface	Hilum
<i>Cuscuta campestris</i>	1-1.5 x 1-1.5	Light-dark brown & black at hilum	Angular, obovate-subreniform	Ruminately foveate	Sub basal
<i>C. europaea</i>	1-1.5 x 0.5-1	Dark brown- black & black at hilum	Angular, broadly obovate-globose	Alveolate	Sub basal
<i>C. gigantea</i>	3.5-4 x 2.5-3	Black	Angular, broadly obovate-triangular	Depressed centrally & rugose	Indistinct
<i>C. hyalina</i>	1-1.5 x 0.5-1	Dark brown-black & black at hilum	Angular, obovate- globose	Rugosely foveate -reticulately foveate	Sub basal
<i>C. lehmanniana</i>	2-2.5 x 1.8-2	Black	Angular & elliptic pyriform	Depressed centrally & striate	Indistinct
<i>C. monogyna</i>	4-4.5 x 2-3	Golden brown- black	Angular & elliptic pyriform	Depressed centrally & rugose	Indistinct
<i>C. pulchella</i>	1 x 0.5-1	Brown	Globose-sub cuneate	Alveolate	Sub central
<i>C. reflexa</i>	1 x 1	Brown-black	Angular, globose	Depressed centrally & foveate	Indistinct

Appendix I. List of voucher specimens.  
Taxa Collector, number & herbarium.

<i>Cuscuta campestris</i>	Abrar Hussain s.n. (KUH); S. Abedin 8544 (KUH); S. Khatoon 268 (KUH); S. Abedin & S. Nazimuddin 392 (KUH); M. Qaiser 15 (KUH); S. Abedin 8542, 8545 (KUH).
<i>C. europaea</i>	Jafri & Akbar 2165 (KUH); M. Qaiser & A. Ghafoor 6808, 5403, 6697 (KUH); Saood Omer 201 (KUH); Kamal & M. Qaiser 322, 296 (KUH); Stewart 18591 (RAW).
<i>C. gigantea</i>	T. M. Rajput & S. S. Tahir 1603 (KUH); Shams-ul-Islam Khan 1603 (KUH); Kamal A. Malik & S. Nazimuddin 1583 (KUH); Y. Nasir & Zafar Ali s.n. (KUH).
<i>C. hyalina</i>	Saida Qaiser 349 (KUH); M. Qaiser <i>et al.</i> , 3717, 559 (KUH); S. Abedin 9781 (KUH); S.M.H. Jafri 2463 (KUH); S. M. H. Jafri 2458 (KUH).
<i>C. lehmanniana</i>	Kamal Akhter & M. Qaiser 542 (KUH); S. M. A. Kazmi 6660 (KUH); A. R. Beg 1499 (RAW).
<i>C. monogyna</i>	Kamal A. Malik & S. Nazimuddin 1577 (KUH); Y. Nasir & Zaffar Ali 5798 (RAW).
<i>C. pulchella</i>	A. Ghafoor & S. Omer 2120 (KUH); Hakim Khan s.n.(RAW); Nazim & Sultan 290( KUH).
<i>C. reflexa</i>	M. Qaiser <i>et al.</i> , 8291 (KUH); S. A. Farooqi & M. Qaiser 2457 (KUH); Sadruddin s.n. (KUH); A. A. Qureshi 22 (KUH); S. Abedin & M. Qaiser 957 (KUH); M. Qaiser 324 (KUH).

### Key to the species of *Cuscuta* L.

- 1 + Seeds angular .....3
  - Seeds not angular ..... 2
- 2 + Seeds blackish towards the hilum, surface ruminately foveate ..... *C. campestris*
  - Seeds not blackish towards the hilum, surface alveolate ..... *C. pulchella*
- 3 + Seeds 3.5-4.5 mm long ..... 4
  - Seeds 1-2.5 mm long ..... 5
- 4 + Seeds elliptic pyriform, centrally depressed ..... *C. monogyna*
  - Seeds broadly obovate-triangular, not centrally depressed ..... *C. gigantea*
- 5 + Seed surface alveolate or striate ..... 6
  - Seed surface foveate ..... 7
- 6 + Seeds obovate-globose, surface alveolate, hilum distinct (sub basal) ..... *C. europaea*
  - Seeds elliptic pyriform, surface striate, hilum indistinct ..... *C. lehmanniana*
- 7 + Hilum distinct (sub basal) ..... *C. hyalina*
  - Hilum indistinct ..... *C. reflexa*

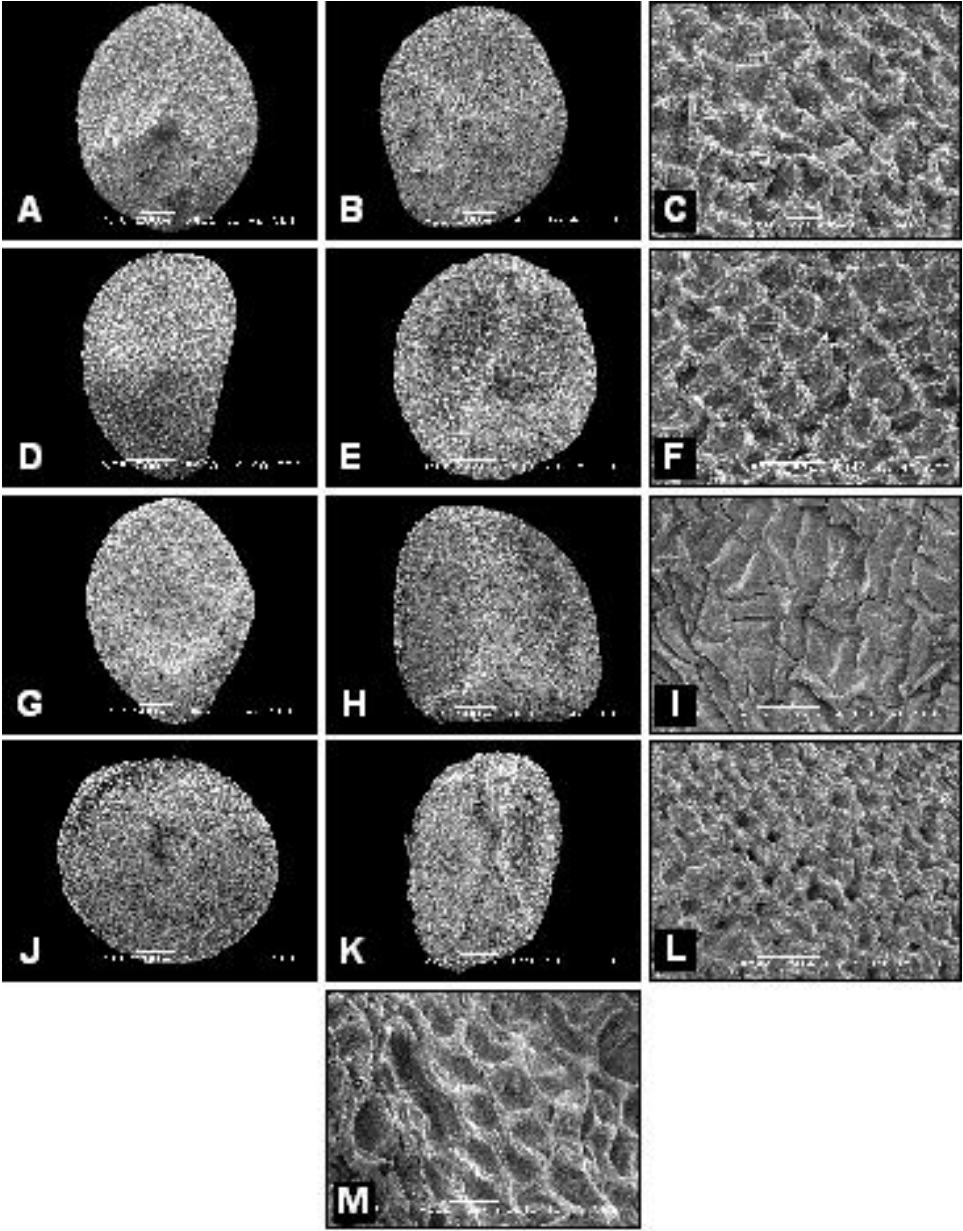


Fig. 1. Scanning electron micrographs. *Cuscuta campestris*: A, B, seed; C, surface. *C. europaea*: D, E, seed; F, surface. *C. gigantea*: G, H, seed; I, surface. *C. hyalina*: J, K, seed; L, M, surface (scale bar: G,H = 500 μm; A,B,D,E,J,K = 200 μm; F,I,L = 50 μm; M = 20 μm).

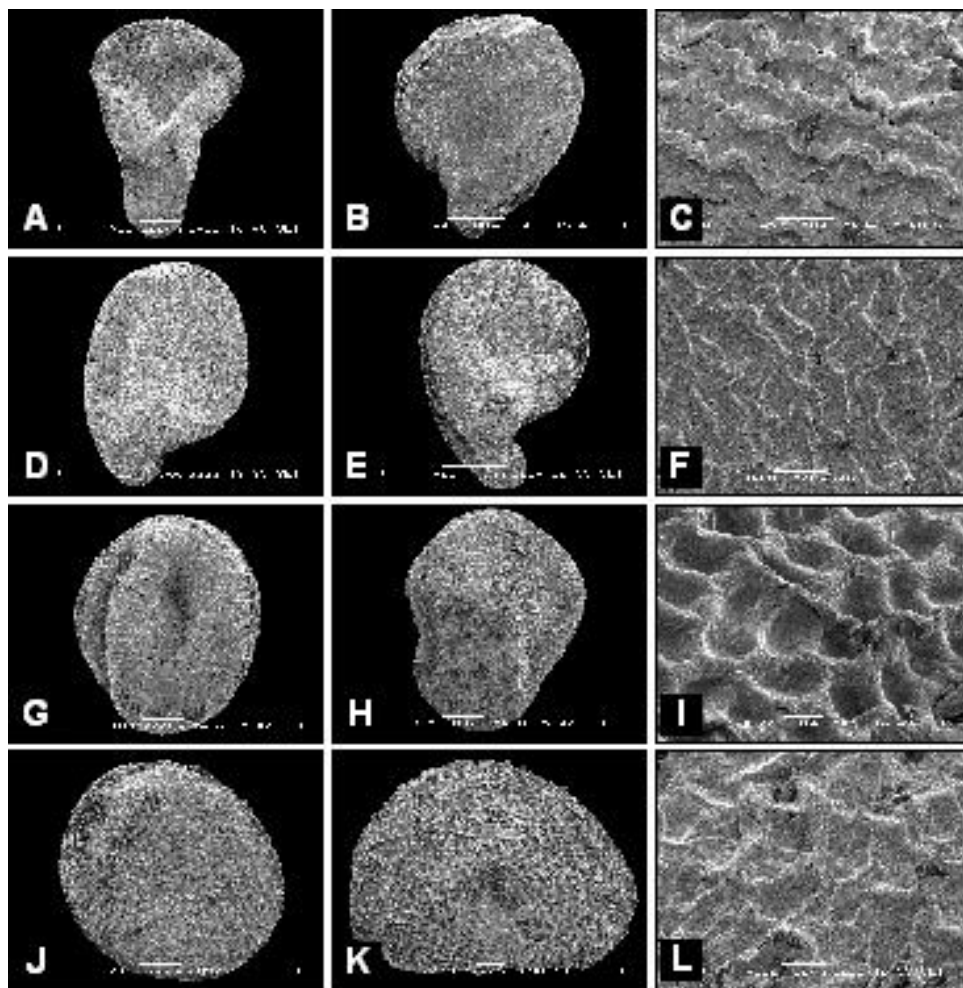


Fig. 2. Scanning electron micrographs. *C. lehmanniana*: A, B, seed; C, surface. *C. monogyna*: D, E, seed; F, surface. *C. pulchella*: G, H, seed; I, surface. *C. reflexa*: J, K, seed; L, surface (scale bar: D,E = 1mm; A,B = 500  $\mu$ m; G,H,J = 200  $\mu$ m; K = 100  $\mu$ m; C,F = 50 $\mu$ m; I,L = 20 $\mu$ m).

## Results and Discussion

The family Cuscutaceae has diverse seed characters (Corner, 1976; Rajput & Tahir, 1988; Jian-Zhong *et al.*, 1993; Fang *et al.*, 1995; Costea *et al.*, 2005; Khalik, 2006; Kirkbride *et al.*, 2006; Bojnansky & Fargasova, 2007) which may play an important role to evaluate taxonomic decisions. All the studied species of the genus *Cuscuta* can be placed in two groups on the basis of angular or non-angular seeds. Taxa with non angular seeds include two species viz., *C. campestris* and *C. pulchella* from which *C. campestris* can be easily distinguished due to the presence of ruminately-foveate seed surface and blackish seeds towards the hilum. While in *C. pulchella* seed surface is alveolate and seeds are not black towards the hilum. It is also noteworthy that in the present investigation sub reniform-obovate seeds have been observed in *C. campestris*, which is in contrast to the findings of Fang *et al.*, (1995), where ovoid seeds have been reported.

Species having angular seeds can be further divided into two sub groups on the basis of seed size i.e., seeds 3.5-4.5mm long and seeds 1-2.5mm long. Within the first sub group *C. monogyna* is characterized by elliptic pyriform, centrally depressed and rugose seeds, while in *C. gigantea* seeds are obovate-triangular, not centrally depressed with rugose surface pattern. However, Jiang-Zhong *et al.*, (1993) and Fang *et al.*, (1995) observed semi spheroidal and sub cordate seeds in *C. monogyna* respectively. Similarly in the second sub group with comparatively smaller seeds, *C. europaea* is characterized by the presence of obovate-rounded seeds with alveolate surface, but these findings are in contrast with the earlier findings of Fang *et al.*, (1995) where elliptic seeds with scabrous surface have been observed. Among the remaining species of the second group, *C. lehmanniana* is characterized by having elliptic pyriform seeds. While the remaining two species *C. hyalina* and *C. reflexa* have obovate-globose and globose seeds respectively. Furthermore, hilum is indistinct in *C. reflexa* and *C. hyalina* has sub basal hilum. However, Ahmed & Qaiser (1989) observed sub circular seeds with areolate surface and basal hilum in *C. hyalina*, but the present findings do not support the previous findings of Ahmad & Qaiser (1989), as angular, obovate-globose seeds with rugosely foveate-reticulately foveate surface and sub-basal hilum have been observed in *C. hyalina*. Similarly, Fang *et al.*, (1995) observed the oblong seeds in *C. reflexa*, but in the present report globose seeds have been observed in *C. reflexa*. Thus it is evident that the seed morphological characters of the genus *Cuscuta* have proved to be very rewarding for the specific delimitation.

## Acknowledgment

This research work is a part of the project “The Seed Atlas of Pakistan”, sponsored by HEC, which is gratefully acknowledged. Thanks are also to the Director, Karachi University Herbarium for providing the facilities of scanning electron microscopy.

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(Received for publication 10 January 2010)