

MACRO AND MICROMORPHOLOGY OF THE SEEDS (CARYOPSIS) IN THE TRIBE PANICEAE (POACEAE) FROM KARACHI-PAKISTAN

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ABSTRACT

Caryopsis of 16 taxa belonging to the tribe Paniceae were studied from the district Karachi. Analysis was done by light and scanning electron microscopy. Micro and macromorphological characters of caryopsis like size, shape, apex, base, margin, ribs, surface and stylopodium were studied. The tribe was characterized by basal hilum. Elliptic shape was found to be the most dominant caryopsis shape. Further, stylopodium was present in all taxa except *Setaria verticillata*. The data obtained from caryopsis micro and macromorphology was found significant as an additional tool to delimit the taxa within the tribe Paniceae from Karachi region.

Key words: Caryopsis, Karachi, Paniceae, Poaceae, Microscopy.

INTRODUCTION

Family Poaceae is one of the most important families of angiosperms, as it provides the three staple crops of the world i.e., wheat, rice and maize. It is the fifth largest family of angiosperms (Khine, 2011) comprising of 6 subfamilies, ca. 60 tribes, 700 genera and 11000 species (Chen et al., 2006). In Pakistan it is represented by 5 sub-families viz., Bambusoideae, Arundinoideae, Chloridoideae, Panicoideae and Pooideae. These 5 sub-families include 26 tribes, 158 genera and 492 species (Cope, 1982). The tribe Paniceae (Sub-family Panicoideae) is the largest tribe of family Poaceae with more than 2000 species worldwide comprising one fifth of the grass family (Duvall et al., 2001). It is represented in Pakistan by 15 genera and 73 species (Cope, 1982) and in Karachi the tribe is represented by 17 species belonging to 11 genera (Jafri, 1966). Many workers delimit taxa of Poaceae on the basis of gross morphology (Cope et al., 1982; Chen et al., 2006; Mabberley, 2008). While, Wang et al. (1986) divided Poaceae into 7 subfamilies on the basis of caryopsis morphology. Later on, many workers used the caryopsis morphology for taxonomic delimitation within the family Poaceae, subfamilies and tribes (Watson and Clifford, 1976; Liu et al., 2005; Gandhi et al., 2016; Arumugam et al., 2020). Besides caryopsis shape, surface and other features, caryopsis size was also found an important taxonomic character (Liu et al., 2005). However, from Pakistan, Usma et al. (2019) described the taxonomic significance of caryopsis in subfamily Panicoideae. But they studied only 13 species including only 2 species from Karachi. Apart from the above information there are no detailed reports available on the caryopsis morphology of tribe Paniceae from the metropolis of Karachi. Present study is an attempt to provide detailed caryopsis characters of Paniceae, that can be used significantly as an aid to taxonomic delimitation within this tribe.

MATERIAL AND METHODS:

Seeds were collected from the vicinity of Karachi and Karachi University Herbarium (KUH) (Appendix I) and analyzed for morphological characters under light microscope (SMZ 800, Nikon Type 102), and Scanning electron microscope (JSM-6380A). For scanning microscopy, dry seeds were directly mounted on metallic stub with double adhesive tape and coated with gold for a period of 6 minutes in the sputtering chamber and were observed under SEM (Ather et al., 2013). The terminology used in accordance to Lawrence (1970), Radford et al. (1974), and Stearn (1983) with subtle modifications.

OBSERVATIONS

GENERAL CARYOPSES CHARACTER OF THE TRIBE PANICEAE

Key to the Genera

- 1 + Stylopodium present.....2
- Stylopodium absent.....*Setaria*

2	+	Caryopsis shape oblong-ovate oblong-obovate.....	<i>Cenchrus</i>
	-	Caryopsis shape not as above.....	3
3	+	Rib present.....	<i>Tricholaena</i>
	-	Rib absent.....	4
4	+	Caryopsis shape elliptic or oblong.....	5
	-	Caryopsis shape not elliptic or oblong.....	9
5	+	Caryopsis apex obtuse, truncate.....	<i>Panicum</i>
	-	Caryopsis apex not obtuse, truncate.....	6
6	+	Caryopsis apex mucronate-obtuse, mucronate.....	7
	-	Caryopsis apex retuse or rounded.....	8
7	+	Caryopsis surface faintly alveolate, rugosely scalariform along with granules.....	<i>Brachiaria</i>
	-	Caryopsis surface undulately ruminant, lineate along with longitudinally ruminant.....	<i>Digitaria</i>
8	+	Caryopsis base rounded, surface rugose.....	<i>Eriochloa</i>
	-	Caryopsis base truncate, surface lineolate along with ruminant, sparsely tuberculate.....	<i>Paspalidium</i>
9	+	Caryopsis shape orbicular.....	<i>Echinochloa</i>
	-	Caryopsis shape obovate or oblanceolate.....	10
10	+	Caryopsis shape obovate, base obtuse-truncate.....	<i>Paspalum</i>
	-	Caryopsis shape oblanceolate, base cuneate.....	<i>Pennisetum</i>

***Brachiaria* (Trin.) Griseb.**

Caryopses 1-2 x 0.5-1.2mm, shape elliptic, apex obtuse-slightly mucronate, base obtuse, margin entire or undulate or serrulate, colour dusty brown, hilum basal, surface faintly alveolate, apically rugosely scalariform along with granulate, stylopodium present (Table 1).

Represented by 2 species viz., *Brachiaria eruciformis* (J.E. Sm.) Stapf and *B. ramosa* (Linn.) Griseb.

Key to the species

- | | | | |
|---|---|---|-----------------------|
| 1 | + | Caryopses breadth more than 1mm with granules..... | <i>B. ramosa</i> |
| | - | Caryopses breadth less than 1mm without granules..... | <i>B. eruciformis</i> |

***Cenchrus* Linn.**

Caryopses 0.8-3 x 0.5-2mm, shape oblong-ovate or obovate, apex obtuse or obliquely truncate-rounded or mucronate-obtuse, base truncate-curved, obtuse, cuneate or rounded, margin entire or undulate, colour egg yellow or dusty brown, with or without longitudinal depression, hilum basal, surface irregularly scalariform or ruminately reticulate, stylopodium present (Table 1).

Represented by 3 species viz., *Cenchrus biflorus* Roxb., *C. pennisetiformis* Hochst. & Steud. Ex. Steud. And *C. setigerus* Vahl.

Key to the species

- | | | | |
|---|---|--|---------------------------|
| 1 | + | Caryopses surface irregularly scalariform..... | <i>C. pennisetiformis</i> |
| | - | Caryopses surface ruminant..... | 2 |
| 2 | + | Caryopses colour egg yellow..... | <i>C. biflorus</i> |
| | - | Caryopses colour dusty brown..... | <i>C. setigerus</i> |

***Digitaria* Haller**

Caryopses 0.8-2.5 x 0.5-1mm, shape elliptic, apex mucronate-obtuse, base truncate or obtuse, margin entire or undulate or dentate or serrulate, colour dusty brown or egg yellow, hilum basal, surface undulately ruminant, lineate along with longitudinally ruminant, stylopodium present (Table 1).

Represented by 2 species viz., *Digitaria adscendens* (Kunth) Henr., *D. nodosa* Parl.

Key to the species

- | | | | |
|---|---|------------------------------|----------------------|
| 1 | + | Caryopses base truncate..... | <i>D. adscendens</i> |
| | - | Caryopses base obtuse..... | <i>D. nodosa</i> |

Echinochloa P. Beauv.

Caryopses 1-2 x 0.8-1.5mm, shape orbicular, apex mucronate-retuse, base obtuse, margin entire or undulate, colour one side off-white and dusty brown at the other side, hilum basal, surface ruminant, stylopodium present (Table 1).

Eriochloa Kunth

Caryopses 1.5-1.9 x 0.7-0.1mm, shape elliptic, apex retuse, base rounded, margin entire or undulate, colour dusty brown, hilum basal, surface rugose, stylopodium present (Table 1).

Represented by single species viz., *Eriochloa procera* (Retz.) C.E. Hubbard.

Panicum Linn.

Caryopses 1.8-2.2 x 0.1mm, shape elliptic or oblong, apex obtuse, acute, base obtuse, cuneate, margin entire or undulate, hilum basal, colour egg yellow, dusty brown, surface undulately foveate and ruminant, reticulate-scribulate, stylopodium present (Table 1).

Represented by 2 species viz., *Panicum antidotale* Retz. And *P. turgidum* Forssk.

Key to the species

- 1 + Caryopses surface reticulate-scribulate..... *P. turgidum*
 - Caryopses surface undulately foveate and ruminant..... *P. antidotale*

Paspalidium Stapf.

Caryopses 1.5-2 x 0.8-1.2 mm, shape elliptic, apex rounded, base truncate, margin entire-undulate, colour dusty brown, hilum basal, surface lineolate along with ruminant, sparsely tuberculate, stylopodium present (Table 1).

Represented by single species viz., *Paspalidium geminatum* (Forssk.) Stapf.

Paspalum Linn.

Caryopses 1.9 x 0.1mm, shape obovate, apex mucronate-rounded, base truncate or obtuse, margin undulate, colour reddish brown, hilum basal, surface lineolate along with scalariform and densely ruminant, stylopodium present (Table 1).

Represented by single species viz., *Paspalum paspalodes* (Michx.) Scribner.

Pennisetum L.C. Rich

Caryopses 3 x 1.5mm, shape oblanceolate, rounded apex- slightly retuse, base cuneate, margin undulate, colour nut brown, hilum basal, surface lineate along with sparsely ruminant, stylopodium present (Table 1).

Represented by a species viz., *Pennisetum divisum* (Gmel.) Henr.

Setaria P. Beauv.

Caryopses 1.1-1.8 x 0.6-1.5mm, shape ovate, apex faintly mucronate, base truncate, margin entire-undulate, colour egg yellow, hilum basal, surface lineate and longitudinally ruminant, stylopodium absent (Table 1).

Represented by single species viz., *Setaria verticillata* (Linn.) P. Beauv.

Tricholaena Schrad.

Caryopses 1.2-1.5 x 0.5mm, shape lanceolate, apex acuminate, base rounded-slightly rounded, margin undulate and serrulate, colour reddish brown, rib, hilum basal, surface appressedly ruminant along with sparsely scalariform, undulately lineolate, stylopodium present (Table 1).

Represented by single species viz., *Tricholaena teneriffae* (Linn. F.) Link.

RESULTS AND DISCUSSION

Angiosperm seeds have acquired considerable variation in their characters, and due to their persistent nature these characters could be helpful for taxonomic delimitation at different levels (Corner, 1976; Stace, 1980; Otto, 2002; Ather *et al.*, 2013; Kanwal *et al.*, 2015). Caryopses are very minute but the detailed morphological characters revealed the existence of variation within the shape and size of caryopses among the family Poaceae (Jamil *et al.*, 2013).

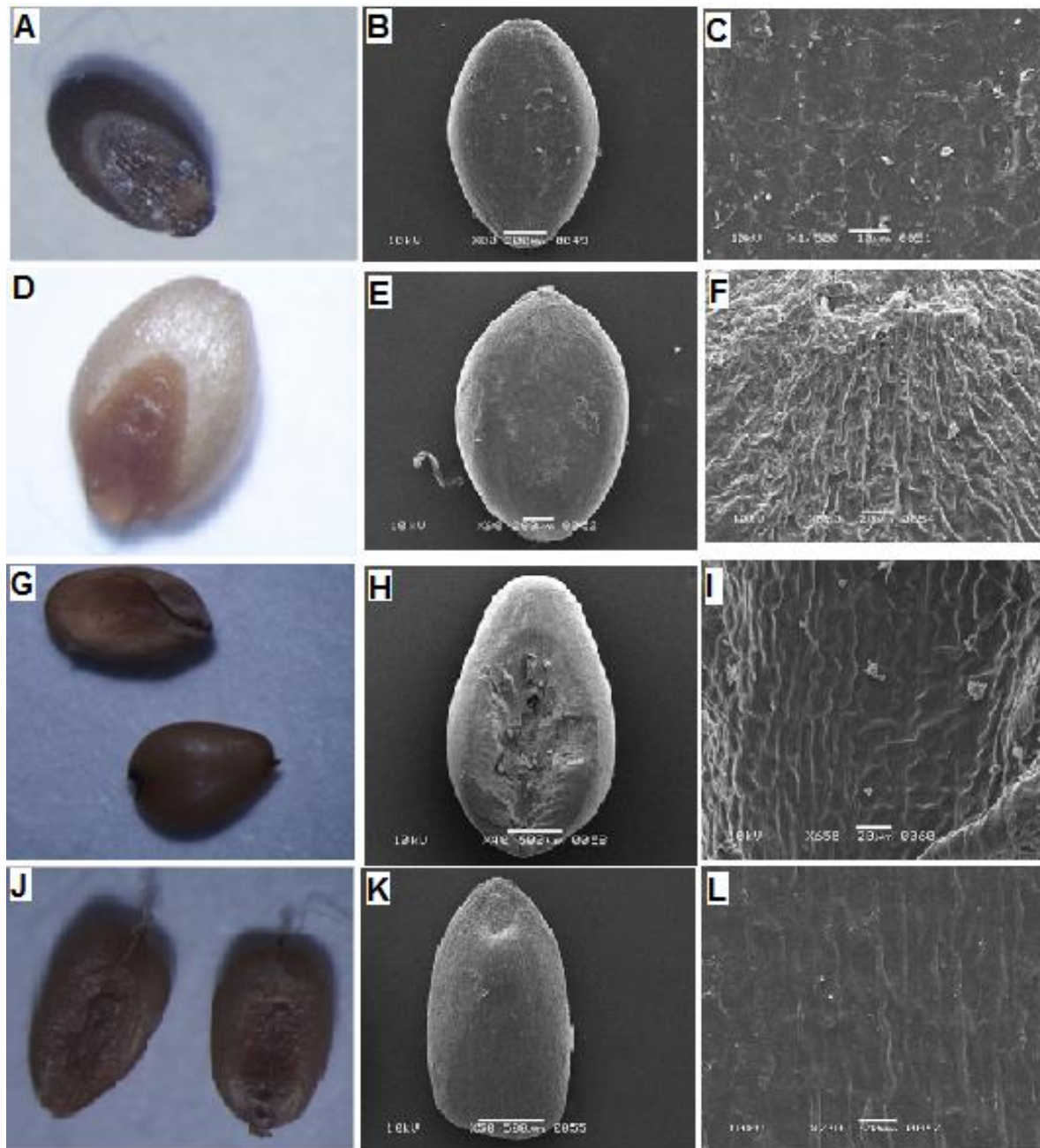


Fig.1. Micrographs of Caryopsis: *Brachiaria eruciformis* A, B, seed, C, seed surface; *B. ramosa* D, E, seed, F, seed surface; *Cenchrus biflorus* G, H, seed, I, seed surface; *C. pennisetiformis* J, K, seed, L, seed surface. (Scale bars: A, D, G, J= 5X; B, E= 200µm; F, I, L=20µm; H, K=500µm; C=10µm).

Many workers delimited the genera within Paniceae on the basis of morphology and spikelets (Cope, 1982; Boonsuk et al., 2016) but caryopsis were little neglected. In the present studies it is found that every genus in this tribe have unique set of caryopsis characters which differentiate it from all other genera. Like, *Setaria* remains distinct within the tribe due to the absence of stylopodium. Similarly, *Cenchrus* have specific caryopsis shape i.e., oblong-ovate or oblong-obovate and *Tricholaena* having lanceolate caryopsis with 1 longitudinal rib. While, other species where ribs are absent can be divided into two groups. One having elliptic or oblong caryopsis includes *Panicum*, *Brachiaria*, *Digitaria*, *Eriochloa* and *Paspalidium*. Out of them *Panicum* remains separate by obtuse,

truncate caryopsis apex. Similar to the previous findings of Pinar *et al.* (2007) seeds surface ornamentation also assumed as a significant feature for taxonomic purposes and the genera *Brachiaria* and *Digitaria* remain distinct by their faintly alveolate, rugosely scalariform along with granules surface and undulately ruminata, lineate along with longitudinally ruminata surfaces respectively. Similarly *Eriochloa* and *Paspalidium* can be differentiated by rounded base and rugose surface in *Eriochloa* and truncate base with lineolate along with ruminata, sparsely tuberculate surface in *Paspalidium*. Second group includes *Echinochloa*, *Paspalum* and *Pennisetum*. Among them *Echinochloa* have orbicular caryopsis, *Paspalum* having ovate and *Pennisetum* having oblanceolate caryopsis.

Table 1. Caryopses morphological characters of the tribe Paniceae

S. no.	Name of Taxa	Size (mm)	Shape	Apex	Base	Margin	Colour	Ribs/Depressions	Surface	Stylogodium
		Length						Rib		
		Breadth						Depression		
1	<i>Brachiaria eruciformis</i>	1-1.5	Elliptic	Slightly mucronate-obtuse	Obtuse	Entire and undulate	Dusty brown	Absent	Faintly alveolate	Present
2	<i>B. ramosa</i>	1-2	Elliptic	Macronate-obtuse	Obtuse	Entire, undulate and serrulate	Dusty brown	Absent	Faintly alveolate, rugosely scalariform along with granules.	Present
3	<i>Cenchrus ciliaris</i>	0.8-3	Oblong-ovate	Obtuse	Truncate-curved and sometimes obtuse	Entire and undulate	Egg yellow	Absent	Ruminata	Present
4	<i>C. peruvianiformis</i>	1.1-2.5	Oblong-obovate	Obliquely truncate-truncate rounded	Obtuse-truncate	Entire and undulate	Dusty brown-egg yellow	Absent	Irregularly scalariform	Present
5	<i>C. setigerus</i>	1.1-2	Oblong-obovate	Macronate-obtuse	Cuneate-rounded	Entire and undulate	Dusty brown	Absent	Ruminately reticulate	Present
6	<i>Digitaria adscendens</i>	0.8-2.5	Elliptic	Macronate-obtuse	Truncate	Entire and undulate	Apex is egg yellow and base is dusty brown	Absent	Undulately ruminata	Present
7	<i>Digitaria nodosa</i>	1.1-2.1	Elliptic	Macronate	Obtuse	Entire, undulate, serrulate, dentate	Dusty brown	Absent	Lineate along with longitudinally ruminata	Present

Table 1. (Cont'd).

S. no.	Name Of Taxa	Size (mm)		Shape	Apex	Base	Margin	Colour	Ribs/Depressions		Surface	Stylopodium
		Length	Breadth						Rib	Depression		
8	<i>Lophochlaena colorata</i>	01-02	0.8-1.5	Oblong	Mucronate-recurse	Obtuse	Entire and undulate	One side is off white and other is dusty brown	Absent	Absent	Ruminant	Present
9	<i>Eriochloa proserpa</i>	1.5-1.9	0.7-0.1	Elliptic	Recurse	Rounded	Entire-undulate	Dusty brown	Absent	Absent	Rugose	Present
10	<i>Pennisetum amabilis</i>	02	0.1	Elliptic	Obtuse	Obtuse	Undulate	Egg yellow	Absent	Absent	Undulately foveate and ruminant	Present
11	<i>Pennisetum turgricum</i>	1.8-2.2	0.1	Oblong	Truncate	Cuneate	Entire and undulate	Dusty brown	Absent	Absent	Reticulate-scribbulate	Present
12	<i>Paspalum semibambusa</i>	1.5-2	0.8-1.2	Elliptic	Rounded	Truncate	Entire and undulate	Dusty brown	Absent	Absent	Lineolate along with ruminant. Sparsely tuberculate	Present
13	<i>Paspalum paspalodes</i>	1.9	0.1	Obovate	Rounded-mucronate	Obtuse-truncate	Undulate	Reddish brown	Absent	Absent	Lineolate along with scalariform and densely ruminant	Present
14	<i>Pennisetum distichum</i>	03	1.5	Oblanceolate	Rounded-slightly recurse	Cuneate	Undulate	Nut brown	Absent	Absent	Lineate along with sparsely ruminant	Present

Table 1. (Cont'd).

S. no.	Name Of Taxa	Size (mm)		Shape	Apex	Base	Margin	Colour	Ribs/Depressions		Surface	Stylopodium
		Length	Breadth						Rib	Depression		
15	<i>Setaria verticillata</i>	1.1-1.8	0.6-1.5	Ovate	Famly mucronate	Truncate	Entire and undulate	Egg yellow	Absent	Absent	Lineate and longitudinal	Absent
16	<i>Tripsolachna tenuiflora</i>	1.2-1.5	0.5	Lanceolate	Accuminate	Rounded	Undulate and serrulate	Reddish brown	01	Absent	Appressedly ruminant along with sparsely scalariform. Undulately lineolate	Present

Similarly at specific level, the two species of *Brachiaria* i.e. *B. eruciformis* and *B. ramosa* can be differentiated from each other by the absence or presence of granules on surface respectively. Among the three species of *Cenchrus*, *C. biflorus*, *C. pennisetiformis*, *C. setigerus*. The *C. pennisetiformis* stands out due to its irregularly scalariform surface. While, *C. biflorus* and *C. setigerus* remains distinct from each other due to egg yellow caryopsis in former and dusty brown caryopsis colour in later one.

Likewise, among the three species of *Digitaria*, *D. adscendens* remains separate due to truncate base of caryopsis and from the remaining two, *D. nodosa* has dusty brown and *D. pennata* has egg yellow caryopsis. Furthermore, the two species of *Panicum* can be differentiated on the basis of caryopsis surfaces i.e., *P. turgidum* has reticulate-scribulate surface and *P. antidotale* with undulately foveate and ruminant caryopsis surface.

Thus, from the above discussion it can be concluded that the caryopsis micro and macromorphological characters strongly support the gross morphological features for the taxonomic delimitation of the tribe Paniceae from Karachi region.



Fig. 2. Micrographs of Caryopsis: *Cenchrus setigerus* A, B, seed, C, seed surface; *Digitaria adscendens* D, E, seed, F, seed surface; *D. nodosa* G, H, seed, I, seed surface; *Echinochloa colona* J, K, seed, L, seed surface. (Scale bars: A, D, G, J= 5X; B, E, H, K = 500 μ m; F, I=100 μ m; C= 50 μ m; L= 20 μ m).

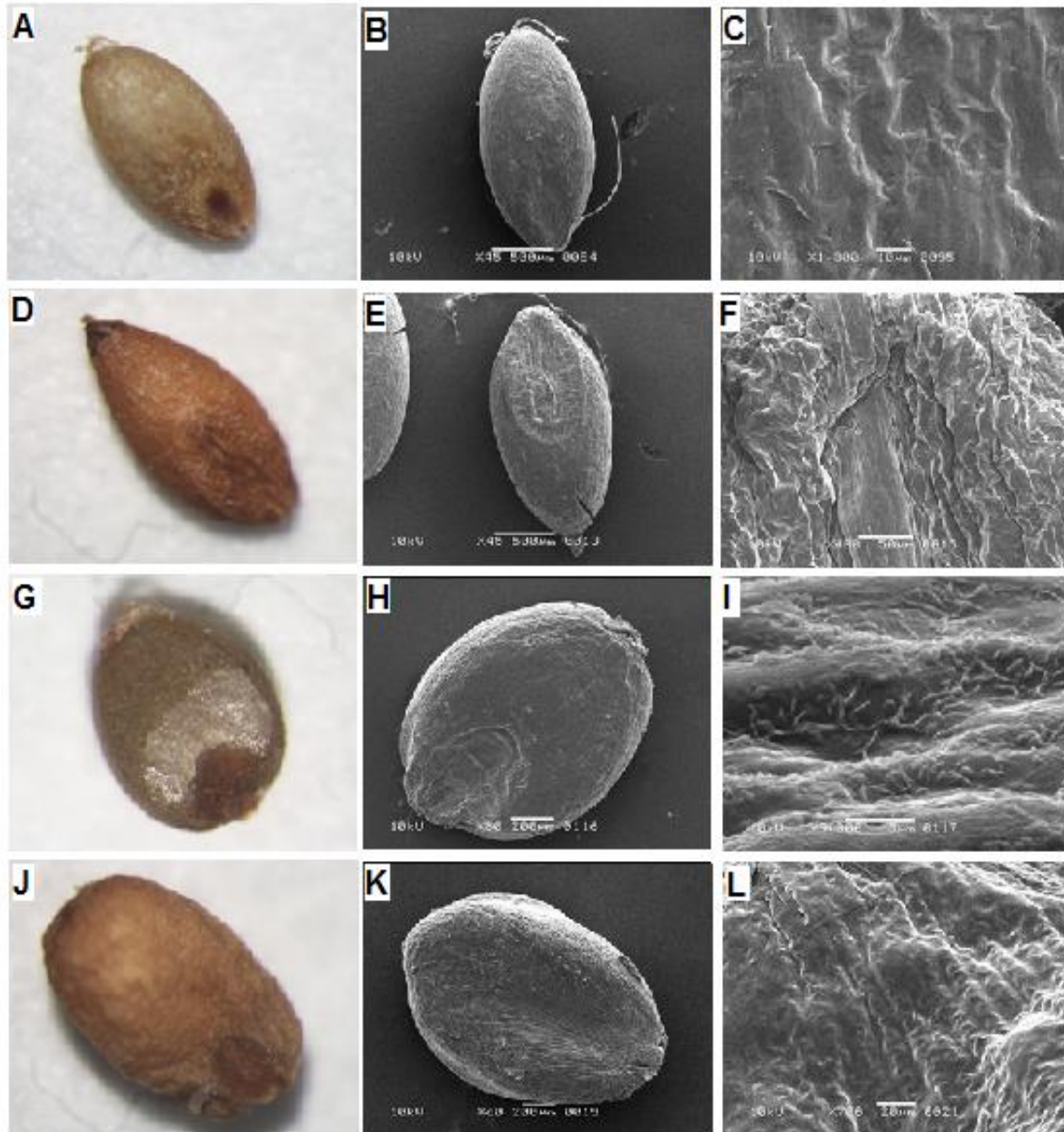


Fig. 3. Micrographs of Caryopsis: *Eriochloa procera* A, B, seed, C, seed surface; *Panicum antidotale* D, E, seed, F, seed surface; *Paspalidium geminatum* G, H, seed I, seed surface *Panicum turgidum* J, seed; *Paspalum paspalodes* K, seed, L, seed surface. (Scale bars: A, D, G, J= 5X; B, E= 500 μ m; H, K= 200 μ m; F=50 μ m; L = 20 μ m; C= 10 μ m; I= 5 μ m).

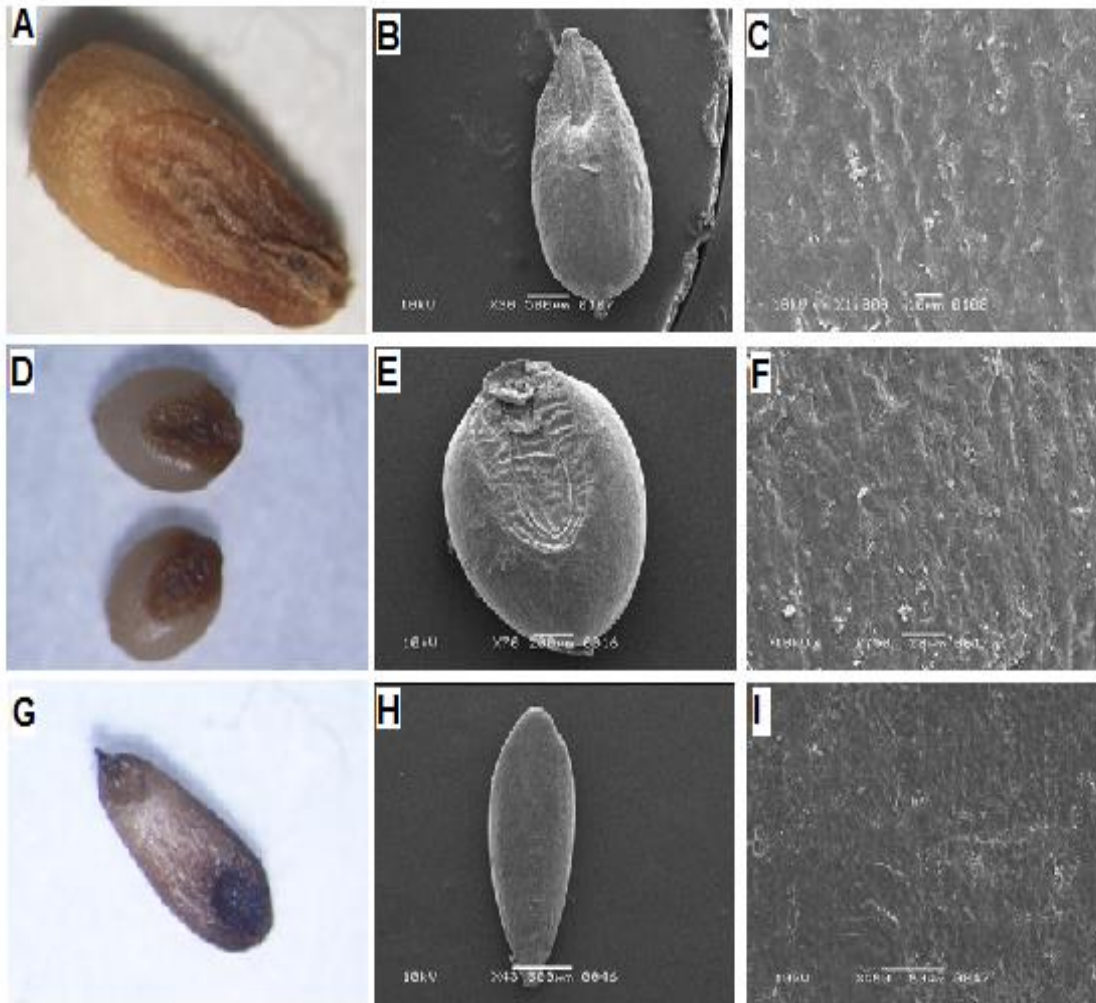


Fig. 4. Micrographs of Caryopsis: *Pennisetum divisum* A, B, seed, C, seed surface *Setaria verticillata* D, E, seed, F, seed surface *Tricholaena teneriffae* G, H, seed, I, seed surface. (Scale bars: A, D, G = 5X; B, H= 500µm; E = 200µm; F = 20µm; C, I=10µm).

APPENDIX-I. List of voucher specimens.

S.no.	Name of Taxa	Collector, number & herbarium
1.	<i>Brachiaria eruciformis</i>	S.I.Ali 11 (KUH); Abrar Hussain <i>s.n.</i> (KUH); Bandelkhund <i>s.n.</i> (KUH); S.A.Farooqi and M.Qaiser 3470 (KUH); M.Maqsood 31 (KUH).
2.	<i>Brachiaria ramosa</i>	R.R.Stewart 27839 (KUH); Yasin Nasir <i>s.n.</i> (KUH); M.Qaiser, A.Ghafoor and Abrar Hussain 3863 (KUH); S.Omer and M.Qaiser 2184 (KUH); Moin, Bushreen and Zeenat 33 (KUH); Bushreen, Zeenat and Nadeem 57 (KUH); Abrar Hussain <i>s.n.</i> (KUH); Tahir Ali, M.Qaiser and Ajmal Khan 111 (KUH); R.R.Stewart 68 (KUH); M.Qaiser, A.Ghafoor and Abrar Hussain 3781 (KUH).
3.	<i>Cenchrus biflorus</i>	Kamal Akhtar and S.Nazimuddin690 (KUH); M.Qaiser, A.Ghafoor and Abrar Hussain 3647 (KUH); Tehmeena Siddiqui 55 (KUH); M.Qaiser, A.Ghafoor and Abrar Hussain 3835 (KUH); S.M.H.Jafri 3902 (KUH); A.Ghaffor 16 (KUH); S.Omer, M.Qaiser and Yasin Nasir 2156 (KUH); S.Omer, M.Qaiser and Yasin Nasir 2154 (KUH); Bushreen, Moin, Nadeem and Zeenat 44 (KUH); Tahir Ali and Tufail Ahmed 1811 (KUH); Nadeem,

		Moin, Zeenat and Bushreen 84 (KUH).
4.	<i>Cenchrus pennisetiformis</i>	Zeenat, Moin, Nadeem and Bushreen 163 (KUH); Dr.S.I.Ali, Dr.S.A.Farooqi and S.Abedin 934 (KUH); Arts Block s.n. (KUH); Mr.Abrar Hussain s.n. (KUH); Mr.Abrar Hussain s.n. (KUH); Tehmeena Siddiqui s.n. (KUH); Saeeda Qureshi s.n. (KUH); M.Qaiser, Saeeda Qureshi and Asad Raza 488 (KUH); Dr.S.I.Ali and Dr.Farooqui s.n. (KUH); Saduruddin, Zeenat, Abrar Hussain, Bushreen, Moin and Nadeem 02 (KUH); S.Omer and M.Qaiser 2785 (KUH); Dr.S.I.Ali and Dr.Farooqi s.n. (KUH); Mr.Abrar Hussain s.n. (KUH).
5.	<i>Cenchrus setigerus</i>	Kamal A.Malik, Saud Omer and Abdul Wahid 2339 (KUH); Mohindra Nath s.n. (KUH); Saduruddin, Moin, Nadeem, Zeenat and Bushreen 50 (KUH); Tahir Ali and Tufail Ahmed 1824 (KUH); Saduruddin, Zeenat, Bushreen, Moin and Nadeem 88 (KUH); Yasin Nasir s.n. (KUH); Sadiq Maseh 8 (KUH).
6.	<i>Digitaria adscendens</i>	Khurshid Rehmani 38 (KUH); S.M.H.Jafri 1274 (KUH).
7.	<i>Digitaria nodosa</i>	Moin, Bushreen and Zeenat 68 (KUH); Tehmeena Siddiqui 87 (KUH); R.R.Stewart 14733A (KUH).
8.	<i>Echinochloa colona</i>	Sultan ul Abedin and Abrar Hussain 9602 (KUH); Coll. 594ngot. 4602 (KUH); G.S.Pari 47 (KUH); Sultan ul Abedin 7418 (KUH); S.M.H.Jafri 1163 (KUH); A.Ghafoor and Tahir Ali 3691 (KUH); Mr.Abrar Hussain s.n. (KUH); M.Qaiser and Sultan ul Abedin 9344 (KUH).
9.	<i>Eriochloa procera</i>	Nadeem and Moin 21 (KUH); Sultan ul Abedin 3880 (KUH); Sultan ul Abedin and Abrar Hussain 950H (KUH); Sultan ul Abedin 5222 (KUH); Yasin Nasir s.n. (KUH).
10.	<i>Panicum antidotale</i>	Coll. 594ngot. 5789 (KUH); Dr.S.I.Ali s.n. (KUH).
11.	<i>Panicum turgidum</i>	Khadija Aziz s.n. (KUH); Saduruddin, Zeenat, Bushreen, Moin and Nadeem 41 (KUH); Abrar Hussain s.n. (KUH).
12.	<i>Paspalidium geminatum</i>	Abdul Ghafoor and Z.L.Butt 882 (KUH); S.M.H.Jafri 2572 (KUH); M.Qaiser, Abrar Hussain and A.Ghafoor 3640 (KUH); S.I.Ali, S.A.Farooqi and Sultan ul Abedin 4278 (KUH); Moin, Bushreen and Zeenat 59 (KUH); Dr.S.I.Ali s.n. (KUH); S.M.H.Jafri 1529 (KUH).
13.	<i>Paspalum paspalodes</i>	Coll. Ingot. S.n. (KUH).
14.	<i>Pennisetum divisum</i>	M.Qaiser 2596 (KUH); S.I.Ali 44660 (KUH).
15.	<i>Setaria verticillata</i>	S.M.H.Jafri 1292 (KUH); Sultan ul Abedin (KUH); Bushreen, Moin, Nadeem, and Zeenat 21 (KUH); Saduruddin, Moin, Nadeem, Bushreen and Zeenat 86 (KUH); Nadeem, Bushreen and Zeenat 9 (KUH); Shamim Akhtar s.n. (KUH); Shamim Akhtar s.n. (KUH); A.Ghafoor and Tahir Ali 3660 (KUH); Abrar Hussain s.n. (KUH).
16.	<i>Tricholaena teneriffae</i>	Tahir Ali 925 (KUH).

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