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On the identity of seven interrelated species of *Eragrostis* (Poaceae: Chloridoideae) in India

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भारत में इराग्रोस्ट्रीस (पोएसी : क्लोरिडॉयडी) की सात परस्पर संबंद्ध जातियों की पहचान

विवेक सी. पी., जी. वी. एस. मूर्ति एवं वी. जे. नायर

सारांश

इराग्रोस्ट्रीस अमाबिलिस, इराग्रोस्ट्रीस सिलिऐरिस, इराग्रोस्ट्रीस सिलिआटा, इराग्रोस्ट्रीस कोआर्कटाटा, इराग्रोस्ट्रीस डेक्कानेंसिस, इराग्रोस्ट्रीस रिपारिया एवं *इराग्रोस्ट्रीस विस्कोसा* जातियां अपने स्पाइकलेट के आसन्धिकरण प्रणाली के आधार पर शीर्ष से नीचे की ओर समानता प्रदर्शित करतीं हैं। इसके अतिरिक्त ये जातियां कई बाह्याकारिकी, पुष्पीय लक्षणों के आधार परस्पर संबद्धता प्रदर्शित करता है। अतएव इनकी परिधी एवं पहचान के मामले में भारत में काफी भ्रम है। प्रस्तुत शोध पत्र इन जातियों के सही अभिनिर्धारण और पहचान करने हेतु विश्वसनीय वर्गिकी जानकारी प्रदान करता है।

ABSTRACT

Mode of spikelet disarticulation in *Eragrostis amabilis, E. ciliaris, E. ciliata, E. coarctata, E. deccanensis, E. riparia* and *E. viscosa* are similar i.e., from apex downwards. Furthermore, they are interrelated in a number of morphological as well as floral characters. Hence, their circumscription and identity have considerable confusions in India. The present study provides the reliable taxonomic characters to distinguish them unambiguously.

Keywords: *Eragrostis,* Identity, India, Poaceae: Chloridoideae

INTRODUCTION

Eragrostis Wolf is the largest genus in the subfamily Chloridoideae of family Poaceae with approximately 423 species distributed in the tropical, subtropical, and warm temperate regions of the world (Clayton & Renvoize, 1986; Ingram & Doyle, 2007; Ingram, 2010; Giraldo-Canas & al., 2012). It is represented in India by 45 species and 9 varieties (Vivek & al., 2015; Veldkamp & al., 2017). The genus is taxonomically complicated because of the close resemblance between many species even with other allied genera such as *Eragrostiella* Bor and *Desmostachya* (Hook.f.) Stapf. These similarities have brought considerable confusions in the delimitation. Recently, the identity problems of three allied species in India viz. *E. atrovirens* (Desf.) Trin. ex Steud., *E. gangetica* (Roxb.) Steud., and *E. nutans* (Retz.) Nees ex Wight & Arn. in which spikelet disarticulation is from below upwards have been dealt (Vivek & al., 2013). The present paper deals with the comparative analysis between *E. amabilis* (L.) Wight & Arn., *E. ciliaris* (L.) R. Br., *E. ciliata* (Roxb.) Nees, *E. coarctata* Stapf, *E. deccanensis* Bor, *E. riparia* (Willd.)

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Nees and *E. viscosa* (Retz.) Trin. where the disarticulation of spikelets is from apex to downwards. The authors while working with the genus in India have noticed many erroneously determined specimens of these species in herbaria, also inconsistencies in the descriptions of earlier floras prepared based on the wrongly determined specimens. The present paper evaluates the reliable characters of the species to distinguish one from the other unambiguously.

MATERIALS AND METHODS

This study is based on herbarium speciemens deposited at BSA, BSD, BSHC, BSI, CAL, FRC, MH, PBL, and RHT and the authors collections and field observations of the species. Illustrations for the habit and important floral parts of taxonomic significance have been prepared. The images of spikelets and caryopses were captured using stereomicroscope (Nikon SMZ 10000). In addition, bracketed key, brief nomenclature citation, description, tables for comparision of characters, and other important details of the species have been provided.

TAXONOMIC ACCOUNT

Key to species

1a. Margins of lemma and palea ciliate throughout 2
1b. Margins of lemma and palea eciliate 4
2a. Panicle much compact, cylindric; stamens 2 3. **E. ciliata**
2b. Panicle less compact, not cylindric; stamens 3 3
3a. Keels of palea not winged, keel cilia long, stiff, thick and with bulbous base 4. **E. coarctata**
3b. Keels of palea winged, keel cilia short, thin and without bulbous base 5. **E. deccanensis**
4a. Cilia on keels of palea equaling to or more than width of palea; cilia at right angles to the body of palea with bulbous base 5
4b. Cilia on keels of palea equaling to or shorter than width of palea; cilia ascending without bulbous base 6
5a. Cilia on keels of palea less prominently bulbous based; stamens 3 1. **E. amabilis**
5b. Cilia on keels of palea much prominently bulbous based; stamens 2 2. **E. ciliaris**
6a. Panicle spiciform or compact, not viscous 6. **E. riparia**
6b. Panicle open or narrowly spiciform, viscous 7. **E. viscosa**

1. Eragrostis amabilis (L.) Wight & Arn., Cat. Indian Pl., Pt. 2, 105, no. 1777. 1834; Hook. & Arn., Bot. Beechey Voy. 251. 1883; Noltie, Bot. Robert Wight: 281. 2005. *Poa amabilis* L., Sp. Pl. 1: 68. 1753. *Eragrostis amabilis* (L.) Wight & Arn. var. *peramangalamensis* Umamahes. & P. Daniel in J. Econ. Taxon. Bot. 22 (1). 211. 1998. *E. tenella* (L.) P. Beauv. ex Roem. & Schult., Syst. Veg., ed. 15 bis 2: 576. 1817; Stapf in Hook.f., Fl. Brit. India 7: 315. 1896; Bor, Grasses Burma, Ceylon, India & Pakistan 513. 1960; Karthik. & al., Fl. Ind. Enum. Monocot. 217. 1989. *Poa tenella* L., Sp. Pl. 1: 69. 1753. *Poa plumosa* Retz., Observ. Bot. 4: 20. 1786. *Eragrostis tenella* P. Beauv. Roem. & Schult. var. *plumosa* Stapf in Hook.f., Fl. Brit. India 7: 315. 1896. *E. tenella* (L.) P. Beauv. ex Roem. & Schult. var. *breviculmis* Stapf in Hook.f., Fl. Brit. India 7: 316. 1896. *E. plumosa* (Retz.) Link, Hort. Berol. 1: 192. 1827; C.E.C. Fisch. in Gamble, Fl. Madras: 1826. 1934.

Culms tufted, geniculate, slender, 19–65 cm high. Leaf sheaths 3–5 cm long; ligule a fringe of short cilia; blades 2.5–12.5 cm long. Panicles lax to slightly spiciform, not viscous, 15–21 × 4–8 cm, branches eglandular, or with minute glands at times. Spikelets 2–3 × 0.8–1 mm. Glumes acute to subacute, margins eciliate or minutely serrulate towards base, membranous. Florets 4–10. Lemmas 0.6–0.8 mm long, apex acute to obliquely truncate, margins eciliate, chartaceous, 1-keeled, scabrid along keel. Paleas 0.6–0.7 mm long, apex acute to obtuse, flap margins eciliate, chartaceous, 2-keeled, ciliate along keels: cilia stiff, almost at right angles to keel, equaling to or more than width of palea with bulbous base. Stamens 3. Caryopses ovoid to ellipsoid, 0.3–0.5 mm long, apex obtuse, light brown in colour.

Flowering and Fruiting: June–December; Stray flowering almost throughout the year.

Habitat: Roadsides, open fields, bunds of paddy fields, waste places, riversides, seashores, plantations, agricultural fields, and on hills; up to an altitude of about 200 m.

Distribution: India: Andaman & Nicobar Islands, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Daman & Diu, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Lakshadweep, Madhya Pradesh, Maharashtra, Meghalaya, Mizoram, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, Uttarakhand and West Bengal; Tropical parts of the world.

Specimens Studied: Andaman & Nicobar Islands: Betapur, 23.07.1974, *N. Bhargava* 1845 (CAL); South

Nicobars, 31–32 km East-West Road, ±100 m, 14.06.1977, N.P. Balakrishnan 5748 (PBL). Andhra Pradesh: Ananthapur Dist., S.K. University Campus, 350 m, 16.06.1981, *T. Pulliah* & *N. Yesoda* 160 (MH). Arunachal Pradesh: Ziro Dist., 28.09.1959, *G. Panigrahi* 19768 (CAL). Assam: Dima Hasao Dist., Haflong-North Cachar Hills, 18.08.1908, *William G. Craib* 298 (CAL). Bihar: Champaran Dist., Nolaipur Forest, 09.11.1963, *B.V. Shetty* 138 (CAL). Gujarat: Anand Dist., Vallabh-Vidyanagar, 27.09.67, *G.L. Shah* 14135 (CAL). Jammu & Kashmir: Pulwama Dist., Bargam, 23.09.1978, *B.V. Shetty* 6694 (CAL). Jharkhand: Hazaribagh Dist., 04.10.1883, *C.B. Clarke* 33813 (CAL). Karnataka: Bangalore Dist., ±914 m, Oct. 1916, *R.D. Arshad s.n.*, serial no. 83363 (MH). Kerala: Kannur Dist., Muzhuppilangad, ±50 m, 16.12.1979, *V.S. Ramachandran* 65263 (MH). Lakshadweep: Kavarathi Island, 04.12.1960, *B.M. Wadhwa* 68669 (CAL). Madhya Pradesh: Bastar Dist., Abujh Marh, 20.05.83, *G.P. Roy* 35218 (CAL). Maharashtra: Bombay State, Dhond, 25.11.1956, *S.K. Jain* 9598 (CAL). Odisha: Cuttak Dist., 15.05.66, *M.K. Ghosh* 77 (CAL). Punjab: Karnal, 25.08.1959, *J.N. Vohra* 8870 (BSD). Rajasthan: Banswara Dist., Bagaycha, 22.10.1976, *V. Singh* 3773 (CAL). Tamil Nadu: Kancheepuram Dist., 2012, *C.P. Vivek* 126161 (MH); Tiruchirapalli Dist., Peramangalam, 26.11.1978, *K.M. Mathew*, *V.S. Manickam* & *C.N. Manoharan s.n.*, acc. no. 19276 (RHT). Tripura: Agartala, 26.09.14, *P.M. Dobbarman* 56 (CAL). Uttarakhand: Kumaon Dist., Bageshwar, 17.09.1957, *T.A. Rao* 4008 (BSD). Uttar Pradesh: Ghaziabad Dist., 04.03.1959, *T.A. Rao* 8264 (BSD). West Bengal: Bankwara Dist., Bilaspur, 12.11.81, *M.N. Sanyal* 1461 (CAL).

Notes: *E. amabilis* has one variety i.e., *E. amabilis* var. *insularis* (C.E. Hubb.) Umamahesw. & Daniel (1998). It is mainly different from the proper by having contracted panicle with less than 1 cm long branches, adpressed to main rachis (Fig. 1). Presently the taxon is distributed in Tamil Nadu and West Bengal in India and Madagascar, Mascarene Island, and Sri Lanka.

2. Eragrostis ciliaris (L.) R. Br. in Tuckcy, Narr. Exped. Zaire 478. 1818; Stapf in Hook.f., Fl. Brit. India 7: 314. 1896; Bor, Grasses Burma, Ceylon, India & Pakistan 506. 1960; Karthik. & al., Fl. Ind. Enum. Monocot. 215. 1989. *Poa ciliaris* L., Syst. Nat., ed. 10. 2: 875. 1759.

[Fig. 1 & Plate 1].

Culms tufted, geniculate, slender, 10–25 cm high; internodes with or without an obscure glandular circle or spots below nodes, not viscous. Leaf sheaths *c.* 1 cm long; ligule a fringe of cilia; blades 1.5–2 cm long. Panicle spiciform, compact, lanceolate to oblong, 2–6 × 1–1.3 cm, branches alternate to subwhorled. Spikelets 1.8–4 × 1.2–2 mm; pedicels eglandular. Glumes acute, margins eciliate, chartaceous, keeled, scabrid or scabrous with 2–5 cilia on keel. Florets 5–10. Lemmas 0.8–1.2 mm long, apex acute to obliquely truncate, margins eciliate, chartaceous, 3-nerved, nerves excurrent, 1-keeled. Paleas deciduous or subpersistent, 0.7–1 mm long, flap margins eciliate, 2-nerved, 2-keeled, long ciliate along keels: cilia stiff, almost at right angles to keel, always longer than width of palea with prominent bulbous base. Stamens 2. Caryopses ovoid to ellipsoid, 0.3–0.5 × 0.2–0.3 mm, yellowish brown.

Flowering and Fruiting: Almost throughout the year.

Habitat: Usually found in dry areas, at times also along wet sandy shores, commonly growing at altitudes between 250–350 m.

Distribution: India: Andhra Pradesh, Bihar, Daman & Diu, Goa, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Punjab, Rajasthan, Sikkim, Tamil Nadu and Uttar Pradesh; Tropical and sub-tropical parts of the world.

Specimens Studied: Andhra Pradesh: Nalgonda Dist., Krishna River bank, 16.12.1959, *K.M. Sebastine* 9819 (CAL & MH). Gujarat: Sourashtra Coast-Bwark-Thor Jungle, 15.10.1961, *T.A. Rao* 439 (CAL). Haryana: Hissar Dist., Rajghat road, 30.11.1961, *N.C. Nair* 18810 (BSD). Jharkhand: Ramgarh, 01.09.64, *B.M. Wadhwa* 5114 (CAL). Madhya Pradesh: Khargone Dist., Bistan, 21.01.1990, *B.K. Sinha* 50345 (BSA). Maharashtra: Bombay State, Taranga Hills, 28.01.57, *S.K. Jain* 11340 (CAL). Punjab: Rohtak Dist., 13.08.1962, *V.J. Nair* 23189 (BSD). Rajasthan: Alwar Dist., Saruska, 26.10.83. *P.J. Parmar* 9601 (CAL). Tamil Nadu: Kancheepuram Dist., Mahabalipuram, 27.09.70, *A.R.K. Sastry* 7621 (CAL). Uttar Pradesh: Allahabad Dist., Chathamline, 28.09.1968, *T. Rajagopal* 4683 (BSA).

Notes: Two endemic infraspecific taxa of *E. ciliaris* have recognized in India, distinguished mainly based on the shape of panicle (Fig. 1). *E. ciliaris* var. *brachystachya* Boiss. (1884) has compact, globular and almost lobed panicle. This taxon is distributed in Gujarat, Haryana, Maharashtra, Rajasthan, Tamil Nadu and Uttar Pradesh. *E. ciliaris* var. *clarkei* Stapf (1896) posess open and 1–2.5 cm wide panicle with scattered spikelets. It is distributed in Delhi, Karnataka and Rajasthan.

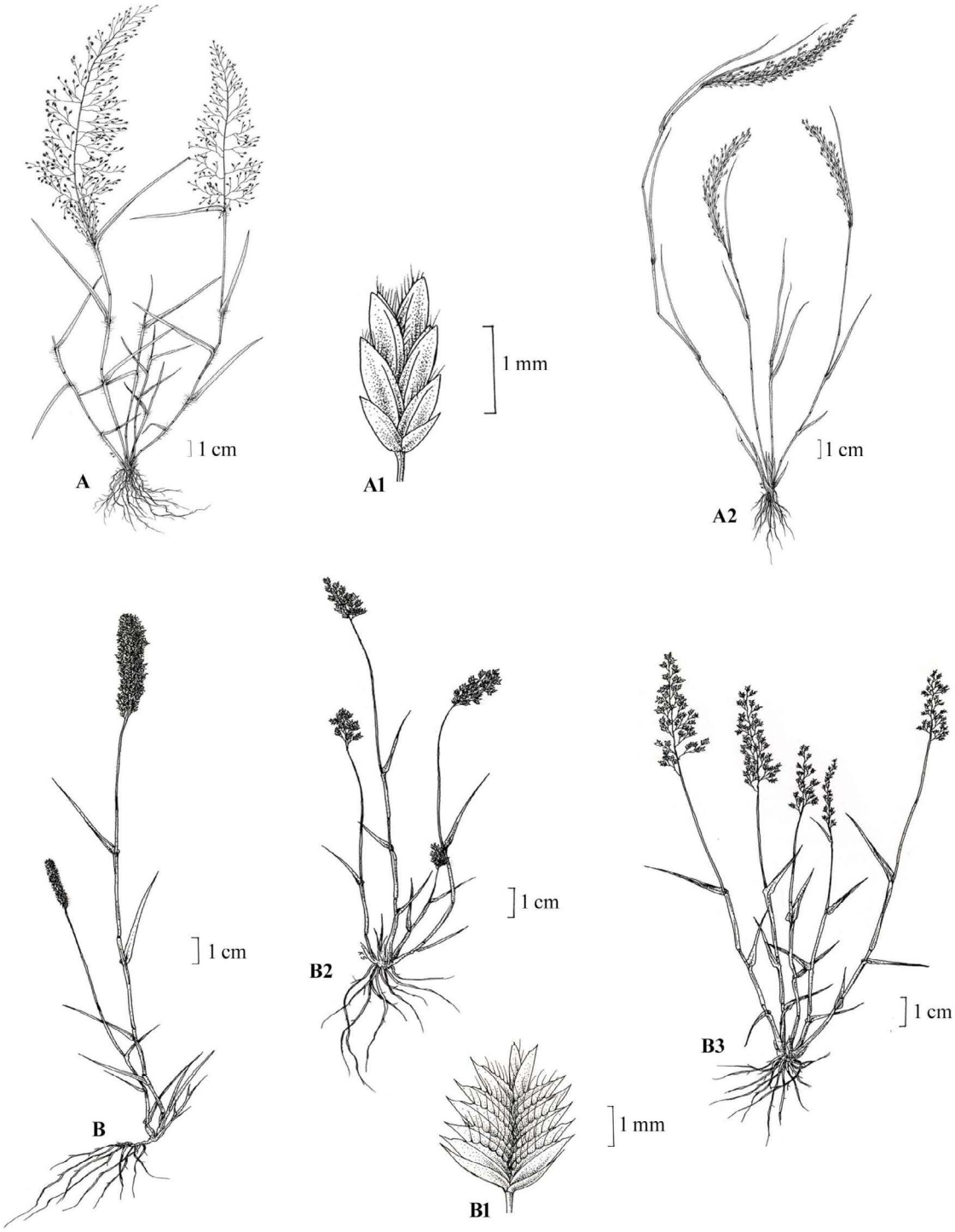


Fig. 1: **A - A1.** *E. amabilis* (L.) Wight & Arn., **A.** Habit, **A1.** Spikelet; **A2.** Habit of *E. amabilis* var. *insularis* (C.E. Hubb.) Umamahesw. & Daniel; **B - B1.** *E. ciliaris* (L.) R. Br., **B.** Habit, **B1.** Spikelet; **B2.** Habit of *E. ciliaris* var. *brachystachya* Boiss.; **B3.** Habit of *E. ciliaris* var. *clarkei* Stapf.

3. Eragrostis ciliata (Roxb.) Steud., Nomencl. Bot., ed. 2. 1: 562. 1840; Stapf in Hook.f., Fl. Brit. India 7: 313. 1896; Bor, Grasses Burma, Ceylon, India & Pakistan 501. 1960; Karthik. & al., Fl. Ind. Enum. Monocot. 216. 1989. *Poa ciliata* Roxb., Fl. Ind. 1: 336. 1820. **[Fig. 2 & Plate 1].**

Culms tufted, geniculate, 60–120 cm high. Leaf sheaths *c.* 5 cm long; ligule a fringe of cilia; blades *c.* 17 cm long. Panicle spiciform, cylindrical, compact, oblanceolate to oblong, 3–8 × 0.5–1 cm, branches alternate to subwhorled. Spikelets ovate to lanceolate, 3.8–5 × 1.5–2.5 mm. Glumes deciduous, linear to lanceolate, apex acuminate, margins ciliate, chartaceous, 1-nerved, keeled, scabrid along keel. Florets 5–10. Lemmas 1.6–1.8 mm long, apex acuminate, margins ciliate, chartaceous, 1-keeled. Paleas 1–1.2 mm long, flap margins ciliate: cilia much closely arranged and ascending above middle, 2-keeled, ciliate along keels: cilia stiff, equaling to or longer than width of palea and minutely bulbous based. Stamens 2. Caryopses ovoid to ellipsoid, 0.4–0.5 × 0.2–0.3 mm, deep brown.

Flowering and Fruiting: Almost throughout the year.

Habitat: Found in open places.

Distribution: India: Andhra Pradesh, Bihar, Gujarat, Jharkhand, Kerala, Maharashtra, Madhya Pradesh, Odisha, Tamil Nadu and West Bengal; S.E. Asia.

Specimens Studied: Andhra Pradesh: Godavari Dist., Kothapalli, 05.09.1907, *C.A. Braber* 8273 (MH); Srikakulam Dist., Palasa, 20.11.55, *M.P. Guha* 193; 20.11.55, *B.D. Patil* 181 (CAL); Visakhapatnam Dist., Bhupathipaliam, 27.09.20, *V. Narayanaswami* 256 (CAL); Itchapuram R.F., 08.12.1923, *K.C. Jacob* 17097 (MH); Maripalli, 13.10.1930, *V. Narayanswami* 4597 (MH). Madhya Pradesh: Bastar Dist., Indravati Tiger Reserve, 13.02.1988, *Anand Kumar* 15584 (CAL); Kutunsar, 19.02.1963, *G. Panigrahi* 1781 (BSA); Narsingpur Dist.: Naringhpur, 18.03.1943, *K. Biswas* 6129 (CAL); Raoghat, 15.02.1961, *N.P. Balakrishnan* & *A.N. Henry* 12145 (CAL & MH); Umaria Dist.: Bandhargarh National Park Shadol-BHP, Way to Umaria, 14.01.1997, *S.K. Srivastava* 45689 (BSA). Tamil Nadu: Tirunelveli Dist., Mundanthorai Ghat, 14.05.1901, *C.A. Barber* 2759 (MH); 22.09.1943, *D. Daniel* & *S.R. Raju* 20431 (MH); Peninsula Ind. Orientalis: 1841, *Wight* 3330 (CAL).

4. Eragrostis coarctata Stapf in Hook.f., Fl. Brit. India 7: 313. 1896; Bor, Grasses Burma, Ceylon, India & Pakistan 506. 1960; Karthik. & al., Fl. Ind. Enum. Monocot. 216. 1989. **(Fig. 2 & Plate 1).**

Culms tufted, geniculate, 10–70 cm high. Leaf sheaths *c.* 4 cm long; ligule a fringe of cilia; blades *c.* 15 cm long. Panicle spiciform, 5–15 × 1–2.5 cm, branches alternate to subwhorled. Spikelets 2–4.5 × 1–2 mm. Glumes acute, margins ciliate, chartaceous, keeled, scabrid along keel. Florets 4–12. Lemmas 1.3–1.7 mm long, apex acuminate, margins ciliate, chartaceous, keeled, scaberulous along keel. Paleas 1.2–1.4 mm long, apex acute to obtuse, fimbriate, flap margins ciliate, chartaceous, 2-keeled, ciliate along keels: cilia equaling to or more than width of palea. Stamens 3. Caryopses ovoid to ellipsoid, 0.4–0.5 × 0.2–0.3 mm, yellowish brown.

Flowering and Fruiting: Almost throughout the year.

Habitat: Grows on sandy soils, roadsides; usually at altitudes between 500 and 1000 m.

Distribution: India: Andhra Pradesh, Assam, Bihar, Chhattisgarh, Haryana, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal; Bangladesh, Myanmar.

Specimens Studied: Andhra Pradesh: East Godavari Dist., Sirivaka, 30.11.1902, *C.A. Barber* 4987 (MH); Khammam Dist., Lakshmipuram Forest, ±250 m, 21,11,1993, *R. Chandrasekaran* 98910 (MH); Nellore Dist., Kollur, 15.12.1917, *C.E.C. Fischer* 4222 (FRC); Krishna Dist., Allur, 19.08.1907, *C.A. Barber* 7940 (FRC); Srikakulam Dist., Korada R.F., 125 m, 12.05.1979, *G.V. Subbarao* 62382 (MH); Visakhapatnam Dist., Araku Valley, 15.09.1961, *N.P. Balakrishnan* 587 (CAL). Bihar: Champaran Dist., 14.04.63, *K. Thothathri* 10087 (CAL). Jharkhand: Ranchi Dist., Koil Karo River, 15.02.1981, *K.C. Malik* 9702 (CAL); Gaya Dist., 28.12.1876, *C.B. Clarke* 31842 (CAL); Singhum Dist., Goelkera, 27.12.1960, *G.V.S. Rao* 23726 (CAL). Madhya Pradesh: Bastar Dist., Chotadongar Nursery, 21.01.1990, *G.P. Roy* 65020 (BSA); Bilaspur Dist., Bilaspur, Feb. 72, *S.K. Murti* 15339 (CAL); Chhindwara Dist., Nagdwari, 01.02.2004, *Parul Sharma* 59645 (BSA); Korba Dist., Gevera, 17.11.2006, *B.K. Shukla* 67380 (BSA); Raigarh Dist., Barumkila, 02.02.1974, *N.C. Rathakrishnan* 19629 (BSA). Odisha: Cuttack Dist., 22.05.1967, *M. Ghosh* 227 (CAL); Ganjam Dist., Boragharo, 20.08.1931, *V. Narayanaswami* 5963 (MH); Koraput Dist., Jamunda, 11.1885, *Prain s.n.,* acc. no. 541184 (CAL); Malkangiri Dist., Orkel, 07.11.1963, *D.C.S. Raju* 1037 (CAL); Sundargarh Dist., Panposh, 02.10.1986, *D. Namhata* 304 (CAL); Sikkim, East Dist., Chaisay on way to Rongli, ±1219 m, 07.12. 1980, *P. Chkrabarty* 1022 (BSHC); West Sikkim., Naya Boyer to Somboriya Road, 11.02.96, *B.K Shukla* & *S.K. Rai* 18638 (BSHC). Uttar Pradesh: Bahraich Dist., Bahraich, 02.1959, *M.A. Rao*

8204 (BSD); Bijnor Dist., Balawali, 12.03.1958, *Y.K. Sarin* 5038 (BSD); Chandpur Dist., 05.03.1962, *C.L. Malhotra* 20236 (BSD); Chitrakoot Dist., Banda, 14.11.1957, *M.A. Rao* 3761 (BSD); Pilibhit Dist., Dhanaraghat, 19.10.1970, *C.L. Malhotra* 42840 (BSD). West Bengal: Birbhum Dist., 16.12.1969, *R.K. Basak* 1241 (CAL); Midnapur Dist., 16.05.63, *G. Sen Gupta* 397 (CAL); Purulia Dist., 20.04.68, *K.C. Malick* 539 (CAL); Chota Nagpur, 12.1880, *J.S. Gamble* 8986; 12.11.1883, *C.B. Clarke* 34086 (CAL).

5. Eragrostis deccanensis Bor, Grasses Burma, Ceylon, India & Pakistan 507. 1960; Karthik. & al., Fl. Ind. Enum. Monocot. 216. 1989. *E. phleoides* Stapf in Hook.f., Fl. Brit. India 7: 313. 1896, *non* Hillebr., 1888. *E. spicata* Jedwabn. in Bot. Arch. 5: 185. 1924, *non* Vasey 1891; C.E.C. Fisch. in Gamble, Fl. Madras 1825. 1934. *Dactylis phleoides* J.G. Klein ex Steud. in Nomencl. Bot., ed. 2. 1: 478. 1840. **[Fig. 2 & Plate 1].**

Culms tufted, geniculate, 30–100 cm high. Leaf sheaths *c.* 4 cm long; ligule a fringe of cilia; blades *c.* 10 cm long. Panicle spiciform with crowded spikelets, 3–10 × 1.2–1.5 mm, branches alternate to subwhorled, very short, adpressed to main axis. Spikelets 6–8 × 2–3 mm. Glumes acute, margins ciliate, chartaceous to coriaceous, keeled, scabrous along keel. Florets 10–16. Lemmas 2.5–3 mm long, apex subacute to mucronate, margins ciliate, chartaceous or coriaceous, 1-keeled, scabrous along keel. Paleas 1.8–2 mm long, apex acute to obtuse, flap margins ciliate, coriaceous, 2-keeled, keel slightly winged towards apex, ciliate: cilia shorter than width of palea. Stamens 3. Caryopses ovoid to ellipsoid, 0.4–0.9 × 0.3–0.5 mm, yellowish brown.

Flowering and Fruiting: September–October.

Habitat: Grows in hilly tracks.

Distribution: India: Endemic to South India: Andhra Pradesh, Karnataka, Kerala, Odisha and Tamil Nadu.

Specimens Studied: Andhra Pradesh: Chitoor Dist., Irumalai Hills, 12.10.1938, *K.C. Jacob* 471 (MH). Karnataka: Bangalore, 04.11.1890, *coll. ign.*, 535, acc. no. 88670 (MH); Sept. 1910, *A. Meebold* 11349 (CAL). Tamil Nadu: Salem Dist., Hosur Cattle Farm, 08.06.1930, *V. Narayanaswami* 3027 (MH).

6. Eragrostis riparia (Willd.) Nees, Agrost. Bras. 2(1): 512. 1829; Bor, Grasses Burma, Ceylon, India & Pakistan 513. 1960; Karthik. & al., Fl. Ind. Enum. Monocot. 217. 1989. *Poa riparia* Willd. in Neue Schriften Ges. Natur. Freunde Berlin 4: 185. 1803. *Eragrostis tenella* (L.) P. Beauv. ex Roem. & Schult. var. *riparia* (Willd.) Stapf in Hook.f., Fl. Brit. India 7: 315. 1896. **(Fig. 2 & Plate 1).**

Culms tufted, geniculate, up to 40 cm high; internodes with a glandular circle below node, not viscous. Leaf sheaths *c.* 4 cm long; ligule a fringe of cilia; blades *c.* 6 cm long. Panicle spiciform with crowded spikelets, lanceolate, *c.* 3 × 1 cm, branches alternate to subwhorled; peduncle *c.* 12 cm long with or without glandular patches below panicle, at times slightly viscous. Spikelets *c.* 2.5 × 1 mm. Glumes acute to subacuminate, margins eciliate, chartaceous, keeled, scabrid along keel. Florets up to 10. Lemmas *c.* 1 mm long, apex acute, margins eciliate, chartaceous, 1-keeled. Paleas *c.* 1 mm long, apex acute to obtuse, flap margins eciliate, at times minutely hairy towards apex, 2-keeled, keel ciliate: cilia ascending, equaling to or shorter than width of palea, without bulbous base. Stamens 3. Caryopses ellipsoid to ovoid, *c.* 0.3 × 0.2 mm, light brown.

Flowering and Fruiting: Almost throughout the year.

Habitat: Grows in red sandy soils, in drier situations on exposed hill slopes, sandy coast, near backwaters and in wastelands and roadsides, found up to an altitude of about 1142 m.

Distribution: India: Andhra Pradesh, Assam, Bihar, Chhattisgarh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal; Myanmar, Papua New Guinea, Philippines, Sri Lanka.

Specimens Studied: Andhra Pradesh: Ananthapur Dist., Kalasamudram R.F. Field, 08.02.1983, *N. Yesoda* 1166 (MH); Chittoor Dist., Irumalai Hills, 12.10.1938, *K.C. Jacob* 472 (MH); East Godavari Dist., Mundapetta, 17.03.1902, *C.A. Barber* 4290 (MH); Nellore Dist., Ramabalaka, Aug. 1883, *J.S. Gamble* 12683 (MH); Visakhapatnam Dist.: 15.05.1964, *G.V. Subba Rao* 19584 (CAL). Karnataka: Bellari Dist., Itagarai, 19.09.1916, *coll. ign.*, 13783 (MH); Chamarajanagar Dist., Hebba Halla, Anepalayam, Kollegal, 762m, 05.07.1930, *V. Narayanaswami* 3584 (MH); Chitradurga Dist., Hosakere, 13.11.1978, *K.P. Sreenath* & *S.R. Ramesh* 4201 (CAL); Mysore Dist., Junkur, 06.12.1940, *K.C. Jacob* 20122 (MH). Kerala: Kollam Dist., Kollam-Backwaters, 22.12.1979, *C.N. Mohanan* 65018 (MH). Madhya Pradesh: Chatarpur Dist., Mohabo, 1983, *B. Datt* 30330 (BSA). Rajasthan: Banswara Dist., Ghautala, 01.01.1966, *R.B. Majumdar* 10223 B (BSA). Tamil Nadu: Coimbatore Dist., Bharathiar University Campus, 27.06.2010, *C.P. Vivek* 126122 (MH); Konamalai-slope, 15.11.1962, *C.P. Sreemadhavan* 258 (MH); Chengalpet

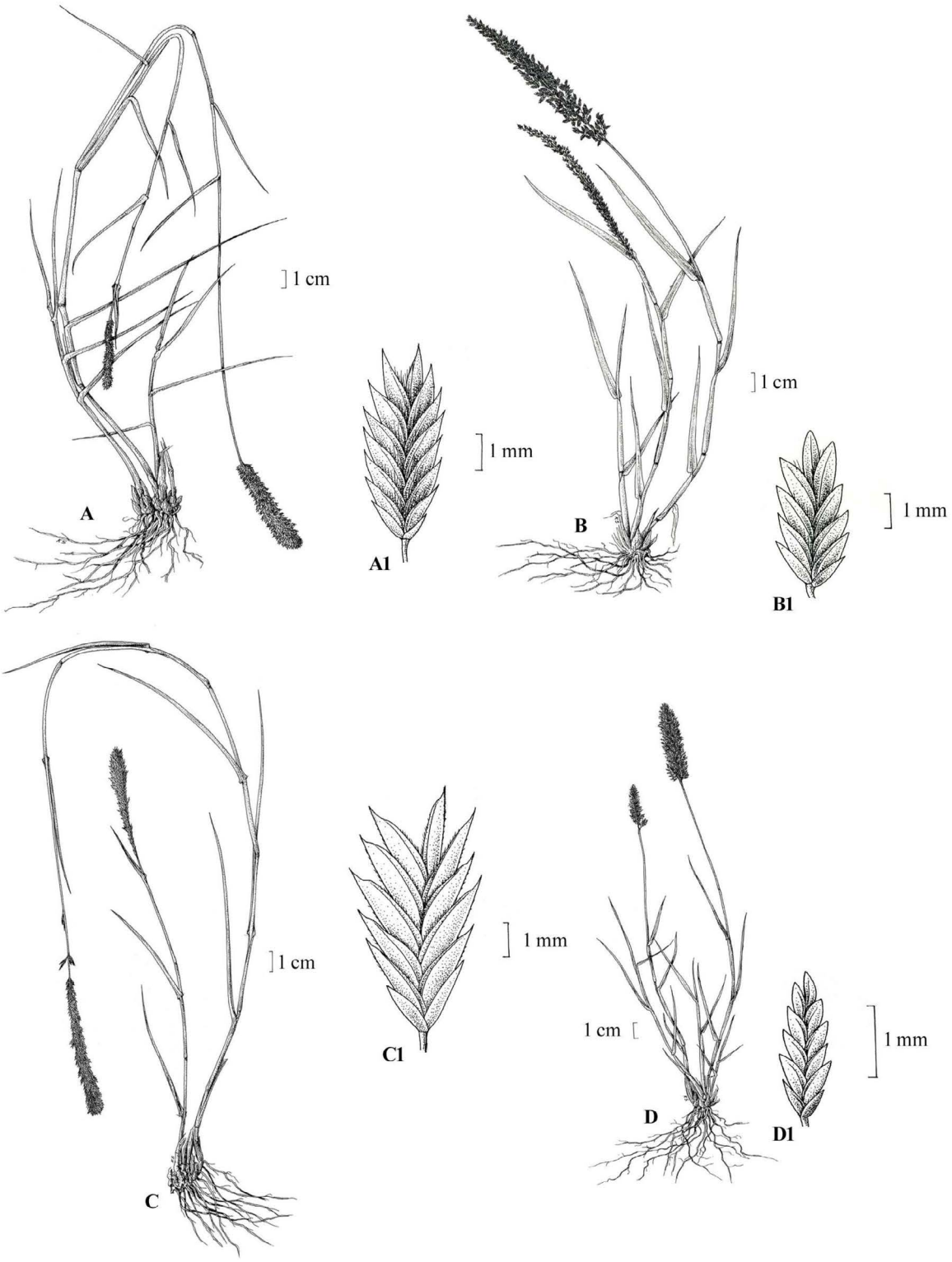


Fig. 2: **A - A1.** *Eragrotis ciliata* (Roxb.) Nees, **A.** Habit, **A1.** Spikelet; **B - B1.** *E. coarctata* Stapf, **B.** Habit, **B1.** Spikelet; **C - C1.** *E. deccanensis* Bor, **C.** Habit, **C1.** Spikelet; **D - D1.** *E. riparia* (Willd.) Nees, **D.** Habit, **D1.** Spikelet.

Dist., Vedanthangal, ±120 m, 28.01.1978, *A.N. Henry* 47096 (CAL & MH); Kanyakumari Dist., Kumari Amman Temple Complex, 22.07.1987, *K. Ravikumar* 85762 (MH); Ramanathapuram Dist., Kurusodai Islands, 30.01.1945, *D. Daniel* & *S.R. Raju* 20082 (MH); Salem Dist., Hosur, 12.12.1917, *coll. ign.*, 15431 (MH); Hosur cattle Farm, 07.06.1930, *V. Narayanaswami* 2956 (MH); Thanjavur Dist., Beach area in Kodikkarai R.F., 13.02.1985, *K.R. Sasidharan* 10989 (FRC); Adyar, July 1889, *J.S. Gamble* 20786 (MH); Tirunelveli Dist., Padaliarkulam Aru Banks, 04.09.1969, *B.V. Shetty* 32215 (MH); Singampatti, 300 m, 14.10.1957, *K.M. Sebastine* 4449 (MH). West Bengal: Bankuara Dist., 1967, *Coll. ign.*, 16 (CAL).

7. Eragrostis viscosa (Retz.) Trin. in Mem. Acad. Imp. Sci. St.-Petersbourg, Ser. 6, Sci. Math. 1: 397. 1830; Bor, Grasses Burma, Ceylon, India & Pakistan 515. 1960; Karthik. & al., Fl. Ind. Enum. Monocot. 218. 1989. *Poa viscosa* Retz., Observ. Bot. 4: 20. 1786. *Eragrostis tenella* (L.) P. Beauv. ex Roem. & Schult. var. *viscosa* (Retz.) Stapf in Hook.f., Fl. Brit. India 7: 315. 1896. **[Fig. 3 & Plate 1].**

Culms tufted, geniculate, 22–76 cm high, viscous; internodes with glandular patches all along or glandular circle or spots below nodes, more or less viscous with sand particles sticking. Leaf sheaths *c.* 3 cm long, viscous around mouth; ligule a fringe of cilia; blades 8–20 cm long. Panicle ovate, open to slightly spiciform, 7–20 × 1.5–6 cm, branches alternate with glandular patches or streaks, more or less viscous; peduncle with glandular patches all along or punctately glandular below panicle, more or less viscous with sand particles attached. Spikelets 2–5 × 0.9–1.5 mm. Glumes more or less viscous, acute, margins eciliate, at times slightly serrulate, chartaceous, keeled, slightly scabrid along keel. Florets 5–11 (–12), more or less viscous. Lemmas 0.9–1.1 mm long, apex acute, margins eciliate, chartaceous, 1-keeled, minutely scabrid towards apex. Paleas 0.9–1 mm long, apex acute to obtuse, margins eciliate, at times minutely hairy towards apex, 2-keeled, keels ciliate: cilia ascending, equaling to or shorter than the width of palea, without bulbous base. Stamens 3. Caryopses ovoid to ellipsoid, 0.4–0.5 × 0.2–0.3 mm, both ends acute or obtuse, reddish brown.

Flowering and Fruiting: Throughout the year.

Habitat: Grows along roadsides, in wastelands, drier areas, in open grasslands and sandy seashores.

Distribution: India: Andhra Pradesh, Assam, Bihar, Daman & Diu, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Nagarhaveli, Odisha, Rajasthan, Sikkim, Tamil Nadu, Uttarakhand, Uttar Pradesh and West Bengal; Tropical and South Africa, Philippines, Malaysia, Myanmar, Sri Lanka.

Specimens studied: Andhra Pradesh: Ananthapur Dist., S.K. University, 350 m, 21.10.1982, *N. Yesoda* 875 (MH); Nellore Dist., March 1918, *C.E.C. Fischer* 4307 (CAL). Bihar: Shahabad Dist., Nov. 1875, *C.B. Clarke* 27415 (CAL). Karnataka: Belgaum Dist., Dharwar, 22.11.1957, *G.H. Khisti* 29640 (CAL). Kerala: Kozhikode Dist., Malaparamba, 30.05.2010, *C.P. Vivek* 126116 (MH). Rajasthan: Sirohi Dist., Gurusikhar-On the way, 10.11.1959, *S.K. Jain* 60185 (BSI). Tamil Nadu: Coimbatore Dist., Aliar Dam nearby, 650 m, 11.05.2011, *C.P. Vivek* 126150 (MH); Bharathiar University Campus, 27.06.2010, *C.P. Vivek* 126121; 22.07.2010, *C.P. Vivek* 126138 (MH); Burliar, 11.05.2010, *C.P. Vivek*, 126111 (MH); Velliangiri Temple nearby, 600 m, 23.10.2011, *C.P. Vivek* 126158 (MH); Ramanathapuram Dist., Alagar Koil Forest, 300m, 27.07.1965, *E. Vajravelu* 25287 (MH); Thoothukkudi Dist., Nazareth, 11.07.1899, *C.A. Braber* 662 (MH); Tirunelveli Dist., Alankolam, Vadugapatti, 29.04.2010, *C.P. Vivek* 126104; 126105 (MH). Uttarakhand: Dehra Dun Dist., Dak Pathar, 15.07.1986, *J.P. Sharma* 70379 (BSD); Rispana, 08.11.1964, *C.R. Babu* 34632 (BSD). Uttar Pradesh: Aligarh Dist., Gangetic Plain, 07.11.87, *J.F. Duthie* 6780; 6785 (CAL); Saharanpur Dist., 11.10.87, *J.F. Duthie* 6781 (CAL).

OBSERVATION AND DISCUSSION

Out of the 45 species of *Eragrostis* reported from India (Vivek & al., 2015; Veldkamp & al., 2017), 9 species have disarticulation of spikelets from apex to downwards viz., *E. amabilis* (L.) Wight & Arn., *E. aspera* (Jacq.) Nees, *E. ciliaris* (L.) R. Br., *E. ciliata* (Roxb.) Nees, *E. coarctata* Stapf, *E. deccanensis* Bor, *E. japonica* (Thunb.) Trin., *E. riparia* (Willd.) Nees and *E. viscosa* (Retz.) Trin. Of these, *E. aspera* and *E. japonica* are evidently distinct from the other members in their morphological as well as floral dissimilarities, thus excluded from the present study. Rest of the seven species are related to one another in many characters, provided confusions in their correct identification.

Interrelationship between *E. amabilis* and *E. viscosa*: The difference between these two taxa including their variable forms are minute with many overlapping characters. *E. amabilis* has three morphological variants.

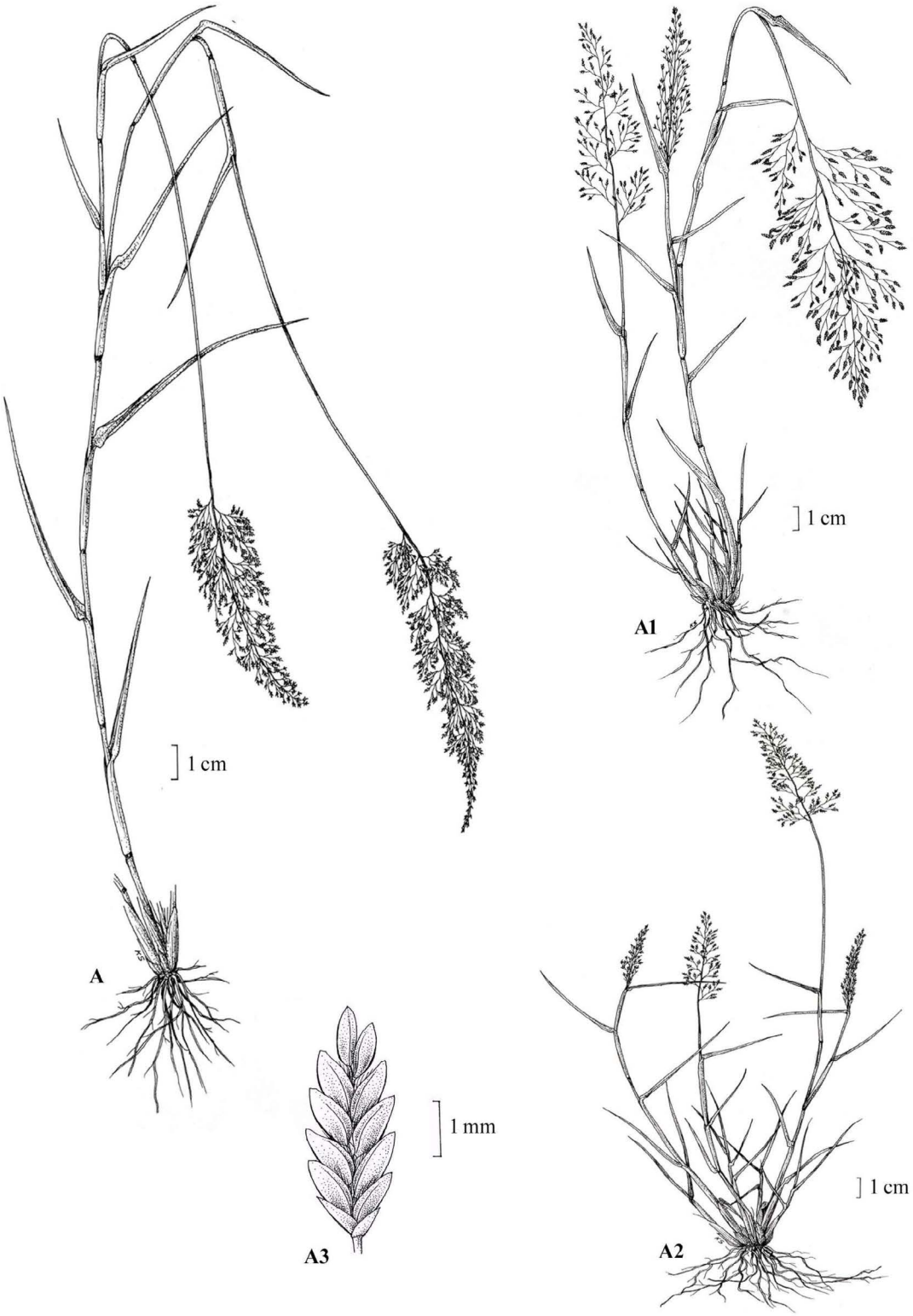


Fig. 3: *Eragrostis viscosa* (Retz.) Trin., **A, A1 & A2.** Habits; **A3.** Spikelet.

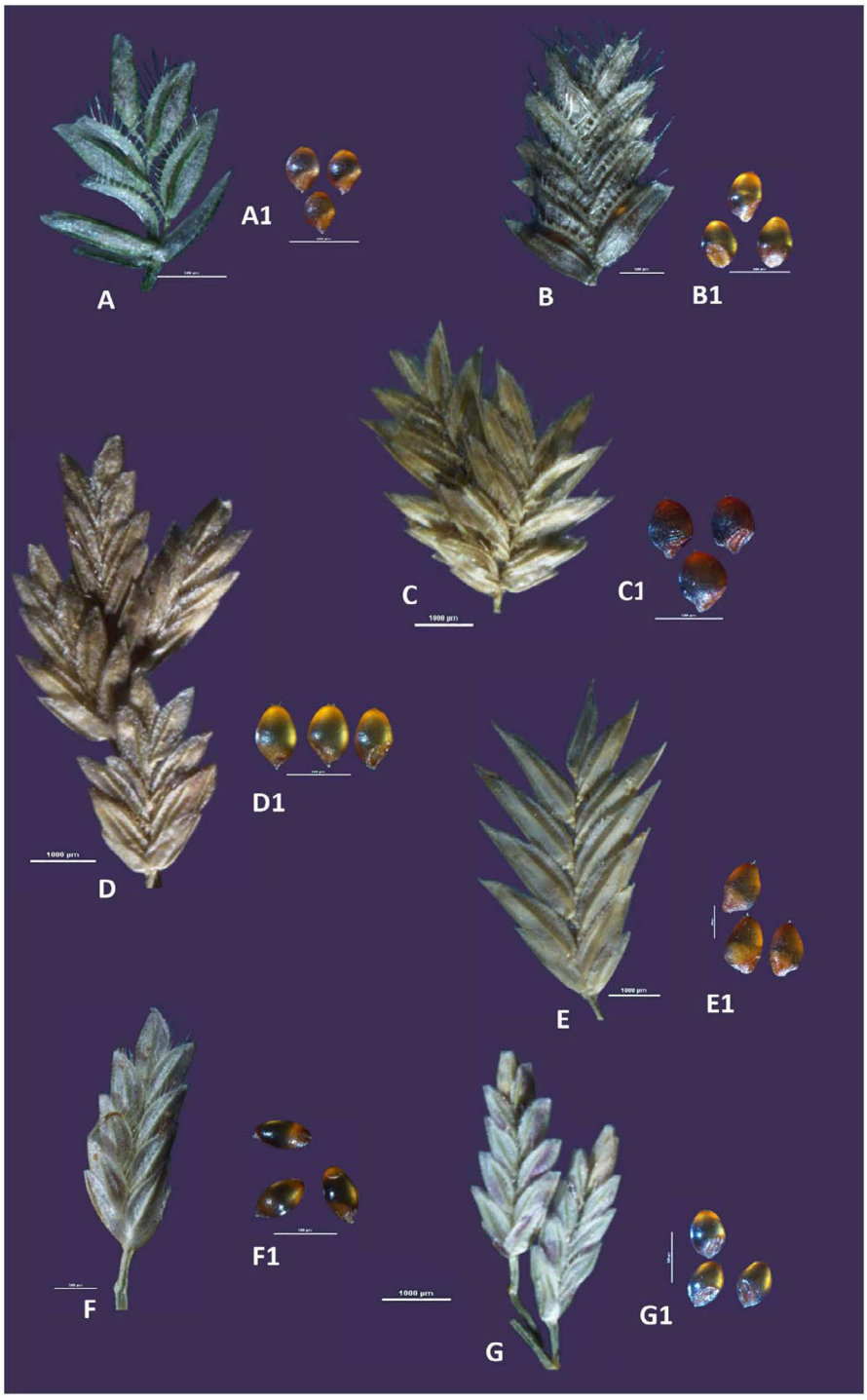


Plate 1: **A - A1.** *Eragrostis amabilis* (L.) Wight & Arn., **A.** Spikelet, **A1**. Caryopses; **B - B1.** *E. ciliaris* (L.) R. Br., **B.** Spikelet, **B1.** Caryopses; **C - C1.** *E. ciliata* (Roxb.) Nees, **C.** Spikelet, **C1.** Caryopses; **D - D1.** *E. coarctata* Stapf, **D.** Spikelet, **D1.** Caryopses; **E - E1.** *E. deccanensis* Bor, **E.** Spikelet, **E1.** Caryopses; **F - F1.** *E. riparia* (Willd.) Nees, **F.** Spikelet, **F1.** Caryopses; **G - G1.** *E. viscosa* (Retz.) Trin., **G.** Spikelet, **G1.** Caryopses.

One form with slender culms, open panicle and pale green spikelets at times shows slight viscosity in field conditions. However, it does not have detectable glands. The second form is very slender with thin, capillary branches and pedicels which bear very small spikelets at the summit, and is often with a plumose habit. Third form is short, somewhat purplish, with narrow, effuse panicle usually found in plains. *E. viscosa* also has three variable forms, of which the common one has open and viscous panicle. Second form has somewhat spiciform and viscous panicle. Third form is morphologically much closure to *E. amabilis*. Though glands are present along panicle branches and peduncle, this form has no viscosity. In earlier publications, *E. viscosa* has been distinguished from *E. amabilis* mainly by the viscosity along peducncle and panicle branches which gives the plant a characteristic smell. However, the viscosity cannot be ascertained in herbarium specimens, thus not reliable. Even shape and colour of the caryopses of both the species are similar (Plate 1). Many collections of *E. amabilis* in herbaria have been wrongly determined as *E. viscosa* because of the uncertainty about the viscosity and closeness of characters.

Interrelationship between *E. viscosa*, *E. riparia* and *E. ciliaris*: The floral characters of *E. viscosa* resemble almost those of *E. riparia* but the latter is distinguished from *E. viscosa* for it has more spiciform panicle and non-viscous glands along panicle branches and peduncle. The spiciform panicle of *E. riparia* has close morphological resemblence with that of *E. ciliaris*. But the panicle branches of *E. riparia* are glandular, and it has 3 anthers. Number of collections of *E. ciliaris* and its varieties are comparatively less in herbaria. Most of the specimens kept under the name of *E. ciliaris* infact belong to *E. riparia*. Inflorescence of *E. ciliaris* appears woolly due to the presence of dense, long cilia on the keels of palea. However, its infraspecific taxa bear comparatively less ciliate palea with the possibility of them being confused with *E. amabilis*.

Interrelationships between *E. riparia, E. coarctata, E. ciliata* and *E. deccanensis*: Contracted panicle of *E. riparia* closely resembles that of *E. coarctata*, thus many collections of the latter have been mistakenly identified as *E. riparia* in the herbaria. Similar panicle of cylindrical and spiciform shape are also found with *E. ciliata* and *E. deccanensis*. However, texture of the spikelets differs in each species, which is more leathery in *E. deccanensis as* compared to *E. ciliata, E. coarctata* and *E. riparia*. Lemma margins of *E. riparia* are eciliate unlike ciliate in *E. ciliata, E. coarctata* and *E. deccanensis*.

The circumscription of these species is thus confusing with the interrelationships and morphological variations. Therefore, the present study provides easily observable and identifiable characters to differentiate one from the other. In order to evaluate the identifying characters, the seven species have arranged in two artificial groups on the basis that they share more similar characters. *E. amabilis, E. ciliaris, E. riparia* and *E.viscosa* are treated in Group I and *E. ciliata, E. coarctata* and *E. deccanensis* are treated in Group II.

All the seven species treated in Group I and group II have been critically studied with their live collections, dried specimens, and literature which could greatly facilitate to confirm the characters involved in panicle, lemma, and palea as reliable and consistent to accurately identify the species. These characters are tabulated in table 1, 2 & 3.

Table 1: Comparison of panicle of taxa in Group I & II

GROUP	SPECIES	CHARACTERS
Group I	*E. amabilis*	Open, (spiciform in var. *insularis*), not viscous
	E. ciliaris	Spiciform, cylindrical, compact (comparatively open in var. *clarkei*)
	E. riparia	Spiciform
	E. viscosa	Open to slightly spiciform
Group II	*E. ciliata*	Spiciform, cylindrical, compact
	E. coarctata	Spiciform
	E. deccanensis	Spiciform

a. Panicle

The overall shape of the inflorescence depends on the nature of primary and secondary panicle branches. The comparative chart provided below explains the differences in panicle arrangements.

b. Lemmas

Margins of lemmas of species in Group I are eciliate and those of Group II are ciliate.

c. Paleas

Difference in the nature of palea can principally consider to confirm the identity of the taxa placed in Group I & II. Nevertheless keels of palea are prominently

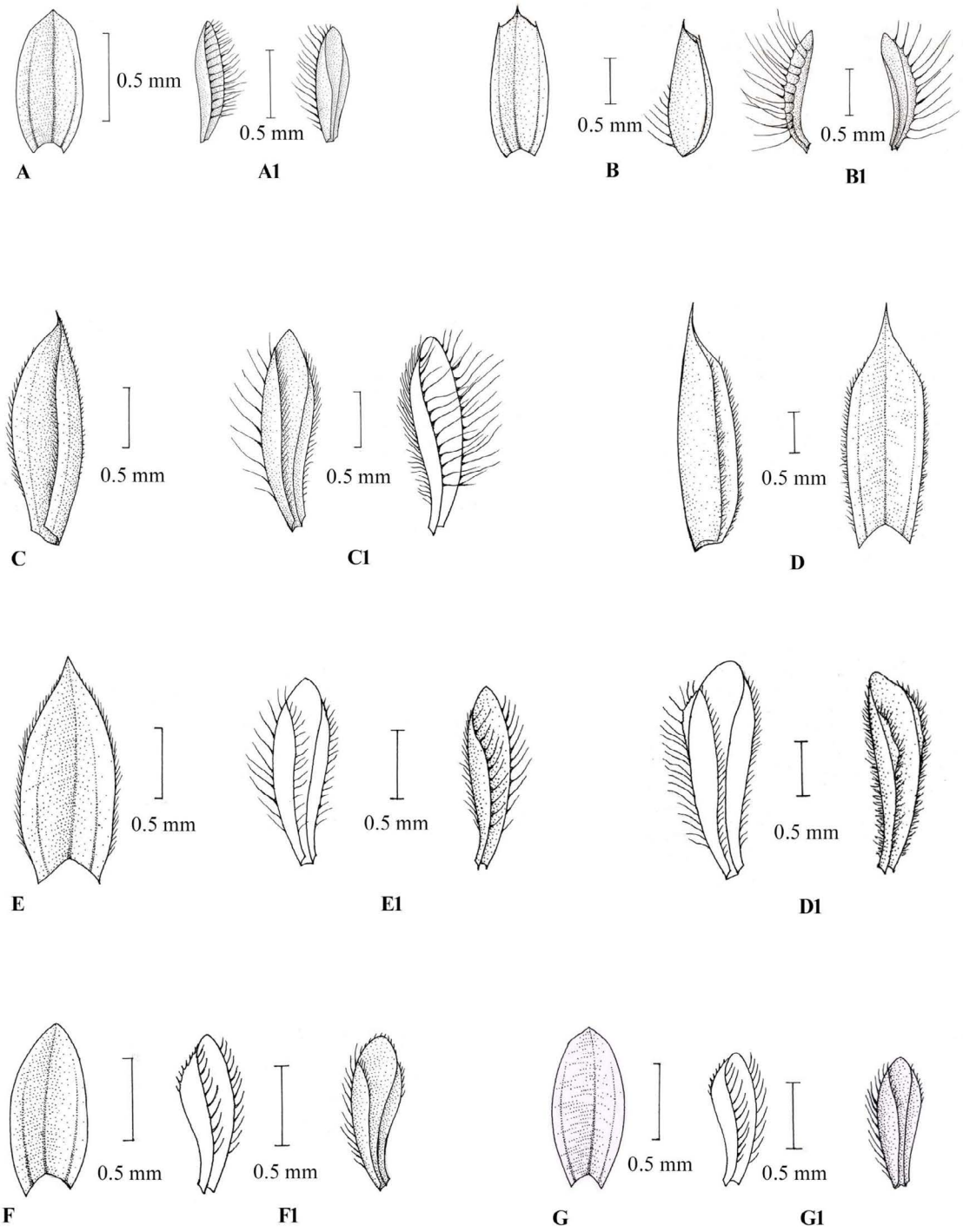


Fig. 4: **A - A1.** *Eragrostis amabilis* (L.) Wight & Arn., **A.** Lemma, **A1.** Palea; **B - B1.** *E. ciliaris* (L.) R. Br., **B.** Lemma, **B1.** Palea; **C - C1.** *E. ciliata* (Roxb.) Nees, **C.** Lemma, **C1.** Palea; **D - D1.** *E. coarctata* Stapf, **D.** Lemma, **D1.** Palea; **E. - E1.** *E. deccanensis* Bor, **E.** Lemma, **E1.** Palea; **F - F1.** *E. riparia* (Willd.) Nees, **F.** Lemma, **F1.** Palea; **G - G1.** *E. viscosa* (Retz.) Trin., **G.** Lemma, **G1.** Palea.

Table 2: Comparison of lemma of taxa in Group I & II

GROUP	SPECIES	CHARACTERS
Group I	*E. amabilis*	0.6–0.8 mm long, apex acute, nerves end at apex, margins eciliate
	E. ciliaris	0.8–1.2 mm long, apex mucronate, nerves excurrent, margins eciliate
	E. riparia	*c.* 1 mm long, apex acute, nerves end at apex, margins eciliate
	E. viscosa	0.9–1.1 mm long, apex acute,nerves end at apex, margins eciliate
Group II	*E. ciliata*	1.6–1.8 mm long, apex acuminate, margins ciliate
	E. coarctata	1.3–1.7 mm long, apex acuminate, margins ciliate
	E. deccanensis	2.5–3 mm long, apex subacute to mucronate, margins ciliate

Table 3: Comparison of palea of taxa in Group I & II

GROUP	SPECIES	CHARACTERS
Group I	*E. amabilis*	0.6–1 mm long, flap margins eciliate, keels not winged, keel cilia long, stiff, right angles to keel, less prominently bulbous based
	E. riparia	0.8–1 mm long, flap margins eciliate, at times negligibly hairy towards apex, keels not winged, keel cilia long, smooth, ascending, not bulbous based
	E. viscosa	0.9–1 mm long, flap margins eciliate, at times negligibly hairy towards apex, keels not winged, keel cilia long, smooth, ascending, not bulbous based
Group II	*E. ciliata*	1–1.2 mm long, flap margins ciliate, keels not winged, keel cilia long, stiff, right angles to keel, less prominently bulbous based
	E. coarctata	1.2–1.4 mm long, flap margins ciliate, keels not winged, keel cilia long, stiff, right angles to keel, less prominently bulbous based
	E. deccanensis	*c.* 2 mm long, flap margins ciliate, keels narrowly winged, keel cilia short, soft, ascending, not bulbous based

ciliate in all the species, pattern of its arrangements or texture in each species is markedly different (Fig. 4). Flap margins of palea of Group I are eciliate except in *E. riparia* and *E. viscosa* where they are negligibly hairy at times. Flap margins of species involved in Group II are prominently ciliate and are unique in appearance.

CONCLUSIONS

The correct identity of *E. amabilis, E. ciliaris, E. ciliata, E. coarctata, E. deccanensis, E. riparia* and *E. viscosa* cannot be confirmed by mere comparison of their morphological characters. They closely resemble in many characters and have morphological variants in the field. Such comparisons often result in misidentifications and inconsistencies with overlapping of characters in the descriptions available in earlier floras. The present paper focus on the the nature of panicle, lemma and palea of the species that are consistent and reliable for correct identification. Of which, differences in palea can be considered as principal character to correctly distinguish them at species level.

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