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First record of true vivipary in *Eragrostiella bifaria* var. *walkeri* (Poaceae: Chloridoideae, Tripogoninae) under cultivated conditions, and a brief note on its taxonomy

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Abstract

This study documents the accidental emergence of viviparous spikelets in *Eragrostiella bifaria* var. *walkeri* observed during a controlled cultivation trial. This phenomenon constitutes the first record of vivipary for the genus *Eragrostiella*. A detailed morphological description of this rare taxon is provided, accompanied by photo plates to aid in precise identification. We discuss the potential environmental and physiological factors that may have triggered this rare event under cultivated conditions, speculating on its biological significance as an acute survival mechanism.

Keywords: Asexual reproduction, endemic plant, gramineae, grass anatomy, India.

The genus *Eragrostiella* Bor historically segregated from *Eragrostis* due to its solitary spike inflorescence bearing second spikelets, contrasting with the panicle of the latter. Phylogenetically, *Eragrostiella* is considered sister to the *Tripogonella* clade (Peterson *et al.*, 2016). *Eragrostiella* is characterised by its multiflowered spikelets and exaristate lemma, a feature that reliably distinguishes it from the closely related genera *Tripogon* Roem. & Schult. and *Tripogonella* P.M. Peterson & Romasch., both of which possess a distinctly aristate lemma. The genus consists of six species distributed across the old-world tropics and subtropics, with five species and two varieties known to occur in India (Lazarides, 1976).

Eragrostiella bifaria var. *walkeri* thrives in the dry, rocky habitats (characterised by sandstone and quartzite substrates) of Andhra Pradesh, South India. Despite inhabiting these xeric conditions, vivipary has not been documented in its wild populations. Gandikota hills, a geologically unique and botanically underexplored region, harbours unique grass flora in South India (Landge *et al.*, 2026).

In its native habitats in Gandikota hills, Kadapa district of Andhra Pradesh, *Eragrostiella bifaria* var. *walkeri* exhibits notably robust growth forms, attaining a height of up to 90 cm (3 feet) (Figure 1). This impressive stature alone allows for easy distinction from its congeners such as, *E. brachyphylla* (Stapf) Bor, *E. bifaria* var. *bifaria* (Vahl) Bor and *E. nardoides* (Trin.) Bor. The inflorescence in var. *walkeri* is typically long and drooping, often measuring up to 40 cm in length. The leaves are evenly distributed on the culms; they are long, flat and drooping, and may reach up to 50 cm long. The lowest leaves clearly exceed the base of the inflorescence. Culms can be 2–4 noded. The spikelets are generally whitish, occasionally displaying a purple tinge on the glumes, lemma apices, and submarginal sides. The spikelet floret count can be exceptionally high, often reaching 50 to 60 per spikelet.

The remarkable numerical superiority observed in the plant habit (height), inflorescence length, and spikelet floret number far exceeds the recorded extremes for any other taxa within the genus *Eragrostiella*. However, Lazarides (1976), viewing this taxon within the broader circumscription of *E. bifaria*, reduced its taxonomic rank to a variety. This treatment may be justified to some extent, as there is a paucity of qualitative characteristics currently available to support its segregation as a distinct species. To resolve this taxonomic uncertainty and confirm its appropriate rank, a molecular phylogenetic approach is strongly recommended.

In the present study, we report the occurrence of true vivipary in the inflorescence of *Eragrostiella bifaria* var. *walkeri* under controlled cultivated conditions. This observation is significant as it constitutes the first published record of true vivipary for the genus *Eragrostiella* and for the entire subtribe Tripogoninae. This finding warrants further investigation into the genetic potential and environmental triggers for vivipary within this taxonomically important group.



Figure 1. Habitats and habit of *Eragrostiella bifaria* var. *walkeri* in Gandikota hill, Kadapa [Cuddapah] district, Andhra Pradesh, India. (Captured on 21 December 2019 by Mr. Shahid Nawaz).

True vivipary is defined as the precocious germination of the embryo into small, separable plantlets while the developing structures remain attached to the mother plant (Goebel, 1905; Arber, 1965; Beetle, 1980; Vega & de Agrasar, 2006). These plantlets subsequently detach and fall to the ground; however, they often exhibit reduced reproductive potential, either remaining strictly vegetative or perishing. Vivipary is sometimes confused with vegetative proliferation (also termed pseudovivipary). Pseudovivipary is distinct because it involves asexual growth and the direct conversion of floral buds into vegetative plantlets, rather than the germination of a sexually produced embryo (Vega & de Agrasar, 2006).

In grasses, vivipary is considered an adaptation to severe climatic conditions, such as alpine, mountain, and arid regions (Tzelev, 1989). Vivipary has been documented across various grass genera, including *Agrostis* L., *Poa* L., *Eleusine* Gaertn., *Sesleria* Scop., *Avena* L., *Bromus* L., *Festuca* Tourn. ex L., *Deschampsia* P. Beauv., *Panicum* L., *Phleum* L., *Setaria* P. Beauv., and *Zea* L. The causal factors are complex, ranging from genetic influences (e.g., hybridization, polyploidy) to adverse environmental stressors (e.g., hormonal imbalance or fluctuation) (Beetle, 1980).

The grass *Eragrostiella bifaria* var. *walkeri*, an Indo-Ceylon disjunct taxon, is consistently observed thriving in dry, rocky areas (sandstone and quartzite) (Figure 1) within Andhra Pradesh, South India, confirming its remarkable desiccation tolerance and resurrection potential. In similar habitats, two more endemic grass taxa are found, viz., *Parahyparrhenia bellariensis* (Hack.) Clayton and *Chrysopogon velutinus* (Hook.f.) Bor, more details on them can be found in Landge & Shinde (2021, 2022, 2023).

An extremely desiccated tuft of the grass was collected from Gandikota Fort hill, Andhra Pradesh, on 21 December 2019, and subsequently planted under controlled cultivated conditions at the grass experimental set-up at St. Xavier's College (Empowered Autonomous Institute), Mumbai, India. The first flowering appeared approximately six months later, in late June 2020, coinciding with the onset of the monsoon in India. Based on the characters such as robust habit, long inflorescence, four nodes on the culms, and leaf blades reaching the base of the inflorescence, the grass was identified using Bor (1960) and Lazarides (1976) as a match for *Eragrostiella walkeri* (now considered as *E. bifaria* var. *walkeri*).

In the same cultivated tuft, after the initial rigorous flowering subsided, accidental emergence of viviparous spikelets was observed in the inflorescence during the first week of October of the same year. The proliferated spikelet possessing a germinated caryopsis was studied under a stereo zoom microscope at Blatter Herbarium (BLAT) to understand its morphology and definitively confirm the occurrence of true vivipary, ruling out pseudovivipary.

Crucially, no instances of vivipary were recorded in natural populations in the wild, suggesting this phenomenon may be a stress-induced response triggered by the specific cultivated conditions (e.g., increased moisture availability) following severe desiccation.

The collected viviparous voucher specimen of *Eragrostiella bifaria* var. *walkeri* has been processed for herbarium preparation and deposited at the Blatter Herbarium (BLAT) for future study.

The viviparously proliferated spikelet was found situated below the middle of the spike (Figure 2). It was confirmed to possess a caryopsis, which rapidly germinated inside the floret. The viviparous spikelet measured up to 0.8 cm in length and consisted of well-developed sheaths, blades up to 25 mm, and a ciliate ligule. Notably, a small portion of a root, emerging from within the lower floret, was visible towards the rachis near the lower involucre glume (Figure 3).

Since the phenomenon of vivipary was not observed in the wild population of *Eragrostiella bifaria* var. *walkeri*, it prompts a consideration of the factors that triggered its emergence under controlled conditions. This rare event, which was not witnessed in any subsequent years after its first emergence, suggests a highly specific or acute environmental stimulus.

Perhaps the sudden change in environmental conditions, specifically the shift from the extremely desiccated wild state to the moisture-rich, cultivated environment, played a role. This change, particularly following the initial recovery and flowering, may have stimulated a survival mechanism in the species. Whether it is due to an acute, stress-induced survival instinct activated by the unusual habitat changes under cultivation is not known.

Morphological description, taxonomy and distribution of *Eragrostiella bifaria* var. *walkeri*

Eragrostiella bifaria* var. *walkeri (Stapf) Lazarides, Contr. Herb. Austral. **22**: 7 (1976). – *Eragrostis walkeri* Stapf in Trim. Handb. Fl. Ceylon **298**. (1900). – *Eragrostiella walkeri* (Stapf) Bor in Ind. Forest. **66**: 270 (1940b). **Type**: SRI LANKA [CEYLON]. Walker s.n. [C.P. 60 pro parte on the label] (K000245121–lecto-type, designated by Lazarides (1994).

Robust, 30–90 cm high, densely tufted, geniculately ascending, glabrous, un-branched, perennial herb. Culms very slender, terete, bases studded with disintegrating fibrous sheaths, striated, glabrous, nodes 2–4, swollen and glabrous. Sheath shorter than the internode, scabrous, striated, terete, somewhat

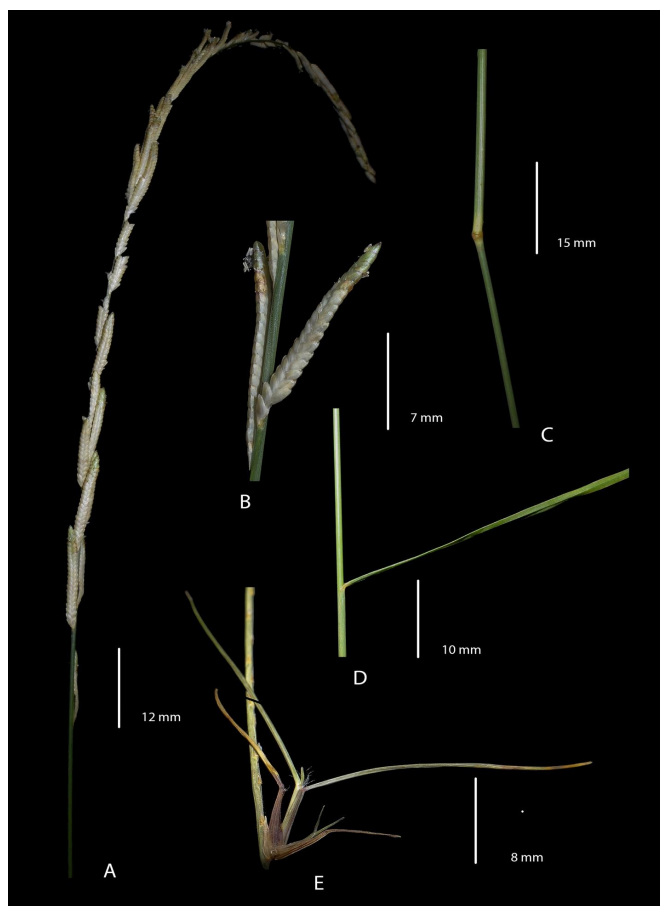


Figure 2. Morphology of *Eragrostiella bifaria* var. *walkeri* (Stapf) Lazarides with viviparous spikelet. A. Spicate inflorescence. B. Normal Spikelets. C. Node and geniculate culm. D. Leaf. E. Viviparous spikelet. (Captured on 5th October 2020 by Mr. Shahid Nawaz).

tightly clasping the culm, except near the mouth and little below, 6.0–8.0 cm in length. Ligule 0.8–2.0 mm long, ciliate to ciliate. Blades sub-auriculate (thin, hyaline, membranous, glabrous extension of the margin of sheath), flat (becoming dry and convolute on maturity), striated, scaberulous and puberulous on intercostal spaces, linear long with attenuate to filiform apices 12–40 × 0.1–0.2 cm; basal leaves longer than their upper cauline counterparts, drooping, drying and somewhat curling at the tips on maturity; leaves reaching fairly above the base of the spike. Inflorescence a spike, up to 35 cm in length, remarkably curling and slightly drooping. Rachis very slender, serrulate on the edges. Spikelets sessile, distinctly white, multi-flowered (up to 50 florets), laterally compressed, linear long, 1.3 × 0.2 (–1.5) cm, biseriately secund, disposed alternately on a rachis. Lower and the uppermost spikelets are smaller than those below and a little above the middle on the rachis. Lower glume ovate adjacent to rachis (adaxial), thin, hyaline, chartaceous, glabrous, 1-nerved, dorsally keeled, keel scabrous (somewhat pectinate in the lower two-third), apex sub-acute, slightly obtuse, 1.3 × 1.5 mm. Upper glume, sub-hyaline, fragile, chartaceous, 1-nerved, dorsally keeled, tip acute, slightly pectinate on the keel, linear-oblong 1.5 × 1.5 mm.

Floret: Lemma (lower two florets in the spikelets are barren) hyaline, membranous, glabrous, 3-nerved, margins broad, apex retuse or obtuse tinged with purple, broadly ovate, 2.5 × 2 mm; palea slightly shorter to its lemma, hyaline, obovate-spatulate, 2-keeled, ciliate on the winged-keel, margin inflexed, broader at the base and tapering upwards, depressed between the keels, apex acute, broadly ovate. Stamens 3, anthers 0.8–1.1 mm in length. Lodicules turgid, in a pair at the base of the ovary, clavellate, slightly tridentate, ca. 0.3 mm. Ovary green, 0.25–0.3 mm in length, tipped with a tubercle protuberance (0.01 mm).

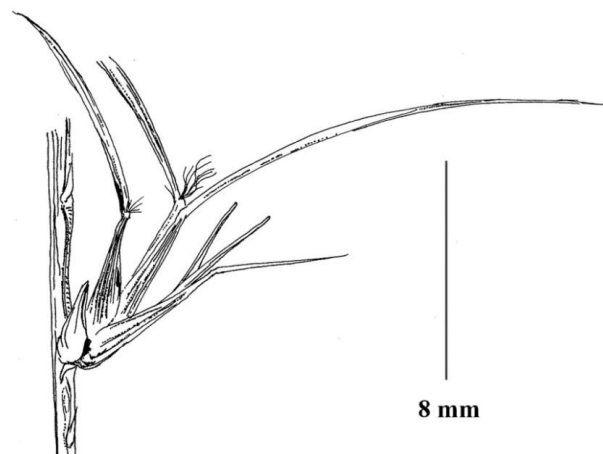


Figure 3. Illustration of the viviparous spikelet in *Eragrostiella bifaria* var. *walkeri* (Stapf) Lazarides. (Illustrated in October 2020 by Mr. Shahid Nawaz).



Figure 4. Lemma, stamen, caryopsis and ligule of *Eragrostiella bifaria* var. *walkeri*. A. Lemma. B. Anther. C. Caryopsis. D. Close-up of caryopsis. E. Ligule. Scale bar: 1 mm (A, B, C, D, and E). (Captured on 5th October 2020 by Mr. Shahid Nawaz).

Caryopsis, globose-ellipsoid, striate, finely reticulate, reddish brown, 0.7–0.8 mm, embryo laterally wedged, half of the seed.

Habitat & Distribution: In the dry, quartzite and sandstone rocky habitats, growing in meager soil accumulation through rocky crevices. This species is distributed in South India (Karnataka, Andhra Pradesh, Telangana and Tamil Nadu) and Sri Lanka. (Bor, 1940 & 1960; Lazarides, 1976; Kabeer & Nair 2009; Thoiba, 2018; Lakshminarasimhan *et al.*, 2019).

Flowering and fruiting: June–January.

Taxonomic Notes: This particular taxon can be easily distinguished based on combinations of characters such as, the robust habit, wider tufts, culms 2–4 nodded, drooping inflorescences, higher number of florets per spikelet (up to 60 florets), whitish spikelets, lower leaf blades long, initially broad and wide open, and glaucous in appearance, reaching the base of the inflorescence and sometimes also exceeding it (Figures. 2–4).

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

DATA AVAILABILITY

All the data available to authors have been provided in the paper.

AUTHOR CONTRIBUTIONS

SNKBL collected the plant specimens from the wild, designed the experimental work, captured the field and experimental photography, and prepared the original manuscript draft. ALG reviewed the original draft and provided critical comments and valuable suggestions during manuscript preparation.

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