

## Original Research Article

### ~~Zeuxine seetharamii (Orchidaceae: Goodyerinae): A new species from Western Ghats,~~ ~~Karnataka, India~~

### Zeuxine seetharamii (Orchidaceae): A new species from the Western Ghats, India

**Commented [s1]:** Title is modified, authors should check

## ABSTRACT

*Zeuxine seetharamii* ~~is has been~~ discovered from ~~the~~ Anshi National Park, Uttara Kannada district, Karnataka, India. It is ~~dissimilar~~ to other species with thick rhizome, dwarf nature, compactly arranged small flowers, ovary structure and seeds. Labellum is similar to *Zeuxine reflexa* having reflexed structure, but pollinarium structure with tegula varies in all *Zeuxine* species from Karnataka and India.

**Commented [s2]:** Authors should thoroughly check the dissimilarity with other *Zeuxine* species.

**KEYWORDS:** Anshi National Park, Leaf litter, Pollinarium, Pubescent inflorescence, Reflexed labellum, Threatened Orchid.

## INTRODUCTION

Orchidaceae is one of the most renowned diversified family among the Angiosperm families, with ~~an~~ estimated count ~~of~~ 26000 species in the World with 762 genera (Mabberley, 2017). Tribe Goodyerine includes 74 species of 13 genera in India. The word *Zeuxine* is derived from the Greek word 'Zeuxis' which means partial fusion of column and labellum or pollinial fusion called 'Yoke'. India has been recorded 19 *Zeuxine* species within two sections called *Zeuxine* and *Psychechilos*. *Zeuxine* section: *Zeuxine* includes three species and *Zeuxine* section *Psychechilos* includes 16 species in India (Bhattacharjee & Chowdhery, 2018). Singh *et al.*, (2019) reported 18 species of *Zeuxine* in India. Lakshminarsimhan *et al.*, (2019) recorded 182 species of Wild Orchids, in that they have included three *Zeuxine* species i.e. *Z. gracilis* (Breda) Blume, *Z. longilabris* (Lindl.) Trimen, and *Z. strateumatica* (L.) Schltr. Punekar & Lakshminarsimhan (2011) documented two *Zeuxine* species (*Z. gracilis* (Breda) Blume & *Z. longilabris* (Lindl.) Trimen) from Anshi National Park. *Zeuxine reflexa* King & Pantling from Anshi National Park, which is ~~a~~ new report to Peninsular India next to Assam and West Bengal from India (Shreyas & Kotresha, 2022).

**Commented [s3]:** Update reference

During a ~~botanical~~ survey at Anshi National Park, the collection of a *Zeuxine* species was done, which was not similar to ~~earlier-collected~~ the four *Zeuxine* species (*Z. reflexa* King & Pantl., *Z. gracilis* (Breda) Blume, *Z. longilabris* (Lindl.) Trimen and *Z. strateumatica* (L.) Schltr.). This newly identified species is differentiated ~~with-by~~ many characters, mainly ~~the~~ size of the plant, ~~the~~

inflorescence, bract with 5-nerved, labellum reflexed, Pollinarium and Seeds. Then it is slightly similar to *Z. clandestina* Blume, which is distributed in Assam and ~~Arunachala-Arunachal~~ Pradesh, but varies in having characters like plant size, leaves, bract, petals, anther cap and Pollinarium. It is not similar to *Zeuxine flava* (Wall. ex Lindl.) Trimen, which is different ~~with-from the~~ yellow coloration and rounded front lobes of labellum (Bhattacharjee & Chowdhery, 2018). *Z. mooneyi* and *Z. andamanica* are not similar to our species as they vary with height, bracts, flower arrangement and lobes of labellum (Misra, 2012; Bhattacharjee & Chowdhery, 2018). Hence, the species is diagnosed as new and named as *Zeuxine seetharamii* from Anshi ~~national-National~~ Park, Uttara ~~kannada-Kannada~~ district, Karnataka.

## TAXONOMIC TREATMENT

*Zeuxine seetharamii* Shreyas & Kotresha sp. nov., (Figure 1 & 2)

### Typus:

India, Karnataka, Uttarkannada District, Anshi National Park, near Nujji village, 03<sup>rd</sup> February 2022, Shreyas B. & K. Kotresha, (Holotype: UASB 5600); - Same locality, 23<sup>rd</sup> February 2023, Shreyas B., (Paratype: HKCD1910).

### Diagnosis

The *Zeuxine seetharamii* is very distinct from other *Zeuxine* species with thick rhizome, dwarf nature compared to *Zeuxine gracilis* and *Zeuxine reflexa*, compactly arranged small flower, ovary structure is dissimilar to *Z. gracilis* and similar to *Z. reflexa*. Labellum is similar to *Zeuxine reflexa* having reflexed structure, but Pollinarium structure and tegula ~~varies-vary~~ in all *Zeuxine* species of Karnataka (including *Z. strateumatica* (L.) Schltr.) (Figure 3, 4, 5 & Table 1).

### Description

Terrestrial herbs c. 19–22 cm tall. Rhizome with root hairs, green, 3–4 cm long. Stem unbranched, erect, 3–5 × 1.2–1.5 cm across, sheathing leaf bases, pinkish-brown, and absence of hairs. Leaves 3–5, scattered around the stem or one above the other ~~sheds, shed~~ during flowering, c. 4 × 1.5 cm, obovate-lanceolate with acute apex. Inflorescence raceme, pubescent, flowers 8–12, 15–16 cm tall, clumped at one place. Bract hairy, brownish-yellow, c. 8 × 5 mm across, with 5-veined, obtuse-lanceolate with acute tip. Flowers unpubescent, ovary pubescent, c. 9 × 6 mm across, cream yellow. Sepals free, greenish-yellow, unpubescent. Dorsal sepal c.3 mm long, obtuse at base and blunt tip, unpubescent. Lateral sepals c. 4 mm long, greenish-yellow, unpubescent, obtuse base and acute apex. Petals transparent white, c. 3 mm long, broad at the apex, entire,

**Commented [s4]:** Authors recorded this species in low altitude or high altitude. Please confirm.

thin at the end. Labellum Y-shaped, c. 4 × 3 mm across, hypochile saccate, creamy yellow with yellowish tinge. Epichile 2-lobed, lobules oblong, creamy white to pale yellowish, slightly reflexed. Labellum saccate has a pair of curved glands with fluid in it. Column c. 2 mm long. Anther cap reddish-yellow, ~~cone-shaped~~ ~~e-cone-shaped~~. 1.5 mm long with two sacks in it. Pollinarium c. 2.2 mm long with transparent caudicle, pollinia more in number, bifid. Tegula oblanceolate and viscidium ~~both are~~ ~~are both~~ transparent, c. 1 mm in length. Ovary sessile, 9 × 4 mm across, greenish-yellow, less pubescent, lanceolate, with spiral ridges on it. Capsule c. 1.1 × 0.3 cm across, pubescent, brownish-yellow.

**Habit:** Terrestrial herbs.

**Habitat:** Semi-evergreen and Evergreen forests under shades with leaf litter, grown with *Zeuxine longilabris* sometimes.

**Flowering & Fruiting:** January-February

**Etymology:** *Seetharamii* is a specific epithet named after an eminent taxonomist Y. N. Seetharam of the Department of Botany, Gulbarga University, Kalaburagi, Karnataka, India.

**Species Examined:** INDIA, KARNATAKA, Uttara Kannada district, Anshi National Park, near Nujji village, 03<sup>rd</sup> February 2022, 15°04'45.0"N 74°21'50.4" E by Shreyas B. & K. Kotresha (0042 & 0111).

#### Key to *Zeuxine* species in Karnataka, India:

- |  |                                |
|--|--------------------------------|
| 1. Flowers white with pale green labellum                                    | <b><i>Z. strateumatica</i></b> |
| 1. Flowers olive green with whitish or yellowish orange labellum             | <b>2</b>                       |
| 2. Labellum c. 1.5 cm long, lobes dentate                                    | <b><i>Z. longilabris</i></b>   |
| 2. Labellum c. 3-6 mm long, lobes erose or incised                           | <b>3</b>                       |
| 3. Labellum reflexed, c. 6 mm long, yellow tinged, lobes erose               | <b><i>Z. reflexa</i></b>       |
| 3. Labellum not reflexed, 3-4 mm across, Orange tinged, lobes incised        | <b>4</b>                       |
| 4. Pollinarium with tegula ovate, Ovary elliptic and more pubescent          | <b><i>Z. gracilis</i></b>      |
| 4. Pollinarium with tegula oblanceolate, Ovary lanceolate and less pubescent | <b><i>Z. seetharamii</i></b>   |

**Commented [s5]:** Authors should clarify the description written on the basis of single specimen or 3-4 specimens of same species in the same habitat.

**Commented [s6]:** Did authors notice any morphological or anatomical variation in roots.

**Commented [s7]:** The authors should confirm the exact flowering and fruiting stage. All recorded 25-30 individuals flowered at the same time. Did the authors noticed it.

**Commented [s8]:** Are latitude and longitude accurate? Are they accurate? up to what distance? Is any GPS position available?

**Commented [s9]:** The authors should incorporate the original photograph of *Zeuxine seetharamii* in its wild habitat.

**Commented [s10]:** What about the altitude of the *Z. seetharamii*. Did the authors record any altitudinal variations?

#### Key to Seed morphometric variations in *Zeuxine* species of Karnataka, India:

- |                                       |                         |
|---------------------------------------|-------------------------|
| 1. Seeds long linear                  | 2                       |
| 1. Seeds short, not linear            | <i>Z. strateumatica</i> |
| 2. Seed testa cells are small         | <i>Z. longilabris</i>   |
| 2. Seeds testa cells long             | 3                       |
| 3. Seed testa cells rectangular       | 4                       |
| 3. Seed testa cells not cuboidal      | <i>Z. seethramii</i>    |
| 4. Seed testa cells 0.08-0.1 mm long  | <i>Z. reflexa</i>       |
| 4. Seed testa cells 0.05-0.07 mm long | <i>Z. gracilis</i>      |

#### CONSERVATION STATUS

As the species collected on the roadside forest edge at riverine habitat, Anshi national Park, 100 meters survey counted 2-3 individuals. Totally, our survey recorded 25-30 individuals. Collected two individuals for analysis and submission of herbarium (Fig. 06). Based on above data the species is at endangered condition and need to be analyzed in future.

**Commented [s11]:** Did the authors observe the same morphological variations in all the 25-30 individuals. If so are they in flowering/fruiting stage.

#### ACKNOWLEDGEMENT

Authors are mainly thankful to the USIC DST SAIF Scanning Electron Microscope analysis, Karnatak University Dharwad for SEM photographs and measurements. Authors are thankful to the Karnataka University for conducting this research programme and providing student research Scholarship (URS). Authors are thankful to Dr. A. N. Sringeshwara, Curator, University of Agricultural Science, Bangalore for herbarium processing and submission. In addition, authors are thankful to Mr. Prashant K. for helping during the survey and collection of the specimen.

#### CONFLICTS OF INTEREST

"The authors declare that there are no conflicts of ~~interests~~interest".

## REFERENCES:

Bhattacharjee, A. & Chowdhery, H.J. (2018). *Fascicles of flora of India*. eOrchidaceae: orchidoideae: cranichidae: subtribe goodyerinae.: 28.140-188.

Laxminarasimhan, P., Dash, S.S., Singh, P., Singh, N.P., Vasudeva, M.K., Rao, P.S.N. & Mao A. A. (2019). *Flora of ~~karnataka~~Karnataka, Karnataka, monocotyledons*. Botanical Survey of India. Vol. 3.: 24.

Mabberley, D. J. (2017). *A portable dictionary of plants, their classification and uses*. Fourth Edition. 652-654.

Misra, S. (2012). A new species of Zeuxine (Orchidaceae) from Rebana Forest of Odisha, India. *Nelumbo*. 54: 17-19.

Punekar, S. & Laxminarashimhan, P. (2011). *Flora of Anshi National Park, Western Ghats-Karnataka*. Botanical Survey of India. 481.

Singh, S. K., Agrawala, D. K., Jalal, J. S., Dash, S. S., Mao, A. A. & Singh, P. (2019). *Orchids of India, a pictorial compendium*. Botanical Survey of India. 514-518.

Shreays, B. & Kotresha, K. (2022). *Zeuxine reflexa* (Orchidaceae-goodyerinae), a new addition to peninsular India, *Rheedea*. 32(3): 218-221.

**Commented [s12]:** Authors should strictly follow the Journal format.

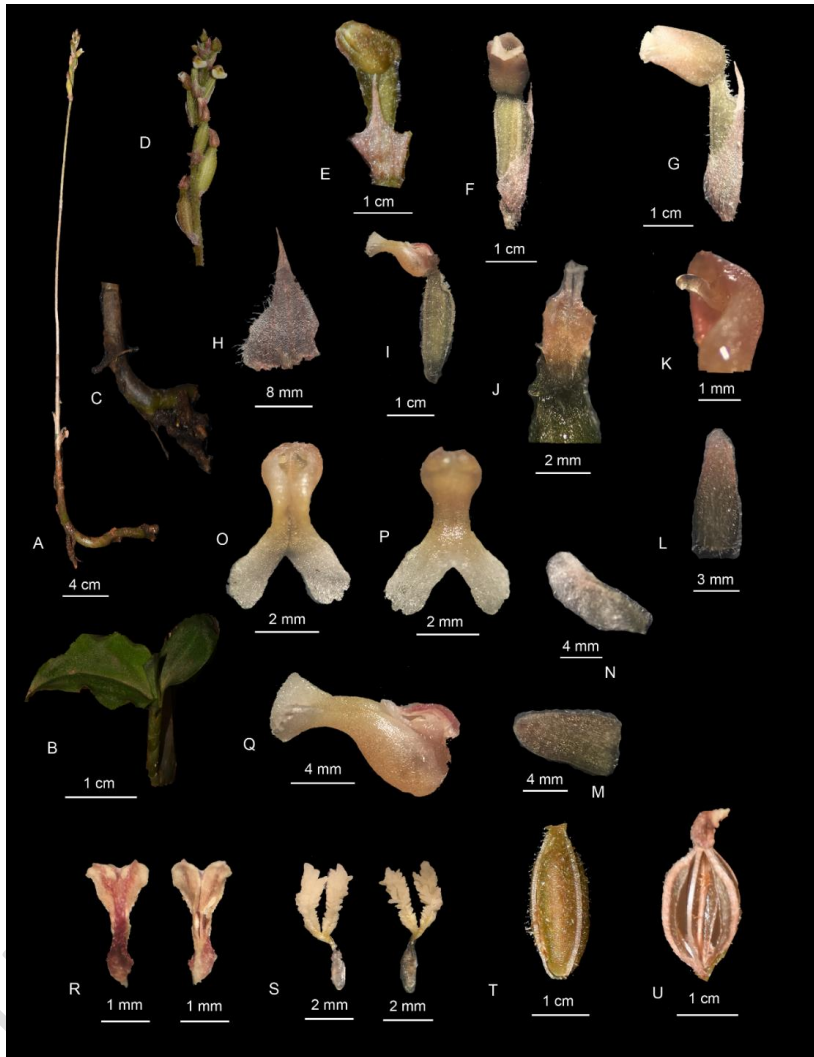
Table. 1: Morphological comparison between *Zeuxine reflexa*, *Zeuxine gracilis* and *Zeuxine seetharamii* sp. nov.

Characters	<i>Zeuxine gracilis</i>	<i>Zeuxine reflexa</i>	<i>Zeuxine seetharamii</i>
<b>Habit</b>	<del>Herbs tall</del> Herbs are tall in size <del>upto-up to</del> 32-34 cm	<del>Herbs tall</del> Herbs are tall in size <del>upto-up to</del> 30-40 cm	Herbs <del>are</del> small in size. <del>upto-up to</del> 19-22 cm
<b>Rhizome</b>	Not elongated, below ground	Not elongated, below ground	Elongated, above ground
<b>Leaves</b>	Leaf base obtuse, acute apex and entire margin	Leaf base obtuse, acute apex and entire margin	Leaf base attenuate, attenuate apex and repand margin
<b>Inflorescence</b>	Raceme with loosely arranged flowers, 15-18 flowers	Raceme with loosely arranged flowers, 12-15 flowers	Raceme with compactly arranged flowers, 8-12 flowers
<b>Bract</b>	c. 5 mm length, ovate-lanceolate, acute at tip, 1-veined	c. 6 mm length, ovate-lanceolate, acuminate at apex, 1-veined	c. 8 mm length, obtuse-lanceolate with acute apex, 5-veined
<b>Flower</b>	Flowers pubescent, c. 9 mm in length, greenish-yellow	Flowers pubescent, 0.8-1 cm in length, brownish-yellow	Flowers less pubescent, c. 9 mm in length, greenish-yellow
<b>Labellum</b>	Not <del>Y-shaped</del> <del>Y-shaped</del> , c. 3.6 x 3 mm across, hypochile orange, white, oblong.	Y- shaped, c. 6 x 4 mm across, hypochile white, cream yellow, reflexed	Y- shaped, c. 4 x 3 mm across, hypochile orange, white, slightly reflexed, dentate at two lobes.
<b>Anthercap</b>	Anther cap reddish orange cone, 2mm long, lower beak like	Anther cap reddish orange cone, 2mm long,	Anther cap reddish orange cone, 1.5 mm long, lower beak like

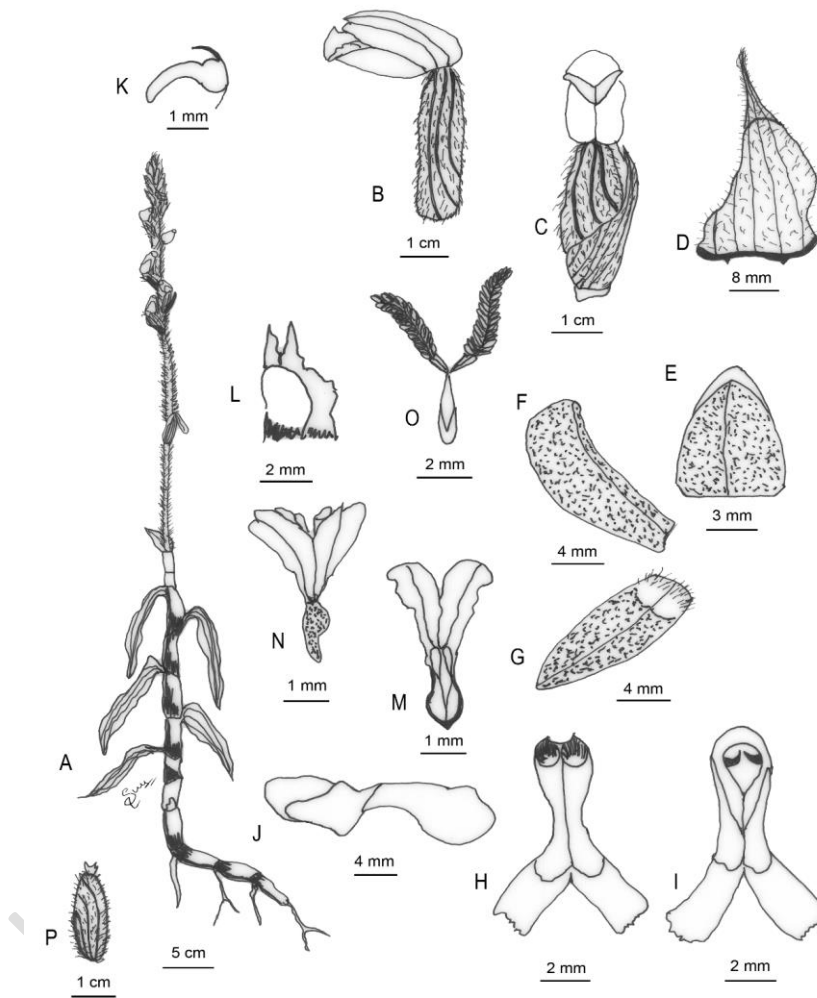
	structure not elongated, with 2 sacs	lower beak like structure slightly elongated, 2 sacs	structure is elongated to hold tegula, 2 sacs.
<b>Pollinarium</b>	1 pair with, tegula ovate	1 pair, tegula lanceolate	1 pair, tegula oblanceolate
<b>Ovary</b>	c. 1 x 0.8 cm across, pubescent, green, narrowly spiral white ridges, elliptic	c. 1.1 x 0.2 cm across, pubescent, brownish-yellow, straight white ridges, ellipsoid	c. 7 x 4 mm across, brownish-yellow, straight white ridges, less pubescent, lanceolate
<b>Seed</b>	Seeds long, linear with testa cells not cuboidal, 0.05-0.07 mm long	Seeds long, linear with testa cells, cuboidal, 0.08-0.1 mm long	Seeds long, linear with testa cells, cuboidal, 0.05-0.07 mm long

**Commented [s13]:** Authors are requested to incorporate the photos of flowering and fruiting.

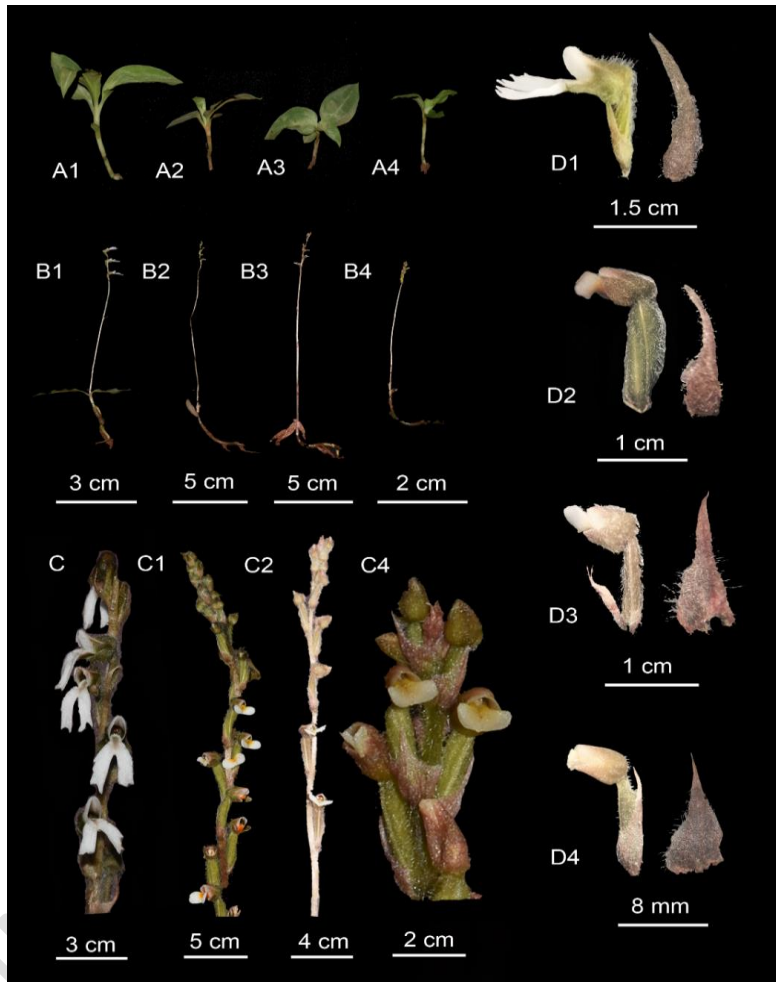




**Fig. 1.** *Zeuxine seetharamii* sp. nova. **A.** Flowering habit. **B.** Vegetative habit. **C.** Rhizome. **D.** Inflorescence. **E.** Flower bud. **F.** Front view. **G.** Lateral view. **H.** Bract. **I.** Column with Ovary. **J.** Column. **K.** Curved gland. **L.** Dorsal sepal. **M.** Lateral sepal. **N.** Petal. **O.** Dorsal view of labellum. **P.** Ventral view of labellum. **Q.** Lateral view of labellum. **R.** Dorsal & Ventral view of Anthercap. **S.** Dorsal & Ventral view of Pollinarium. **T.** ovary. **U.** Dispersed capsule. (Photos by Shreyas Betageri).



**Fig. 2. *Zeuxine seetharamii* sp. nova.:** **A.** Habit, **B.** Lateral view of flower. **C.** Front view of flower. **D.** Bract. **E.** Dorsal sepal. **F.** Petal. **G.** Lateral sepal. **H.** Dorsal view of labellum. **I.** Ventral view of labellum. **J.** Lateral view of labellum. **K.** Curved gland. **L.** Column. **M.** Dorsal view of labellum. **N.** Ventral view of labellum. **O.** Pollinarium. **P.** Ovary. (Illustrated by Shreyas Betageri).

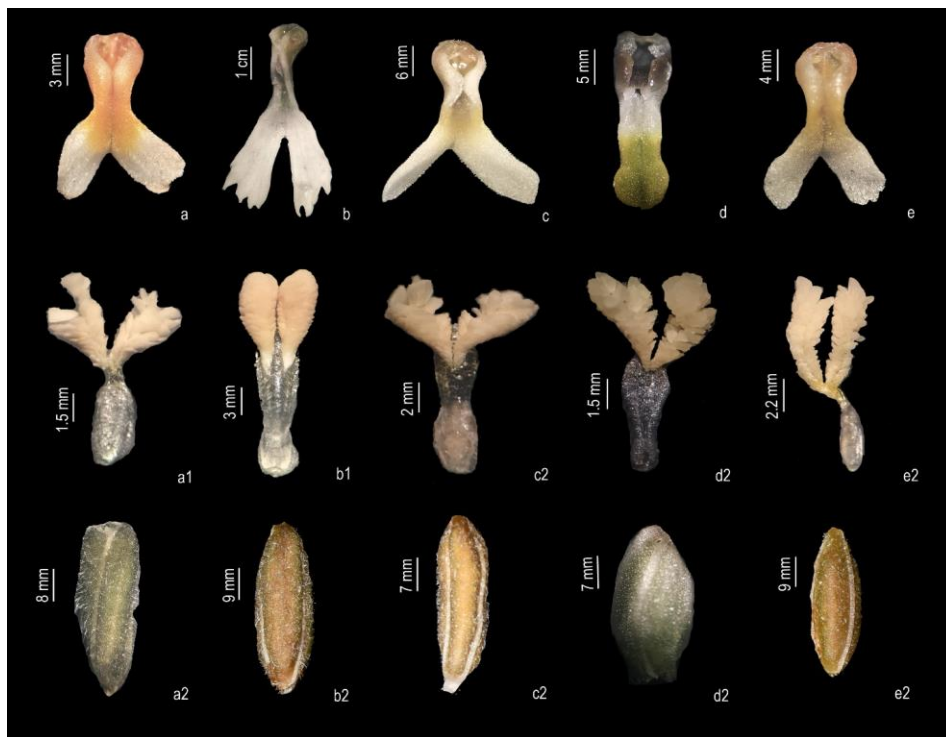


**Fig. 3. Comparative account of Zeuxine species in Karnataka:** Vegetative habit of **A1.** *Zeuxine longilabris* Trimen, **A2.** *Zeuxine gracilis* (Breda) Blume, **A3.** *Zeuxine reflexa* King & Pantl., **A4.** *Zeuxine seetharamii* sp. nova. Flowering habit of **B1.** *Zeuxine longilabris* Trimen, **B2.** *Zeuxine gracilis* (Breda) Blume, **B3.** *Zeuxine reflexa* King & Pantl., **B4.** *Zeuxine seetharamii* sp. nova., Inflorescence enlarged, of **C1.** *Zeuxine longilabris* Trimen, **C2.** *Zeuxine gracilis* (Breda) Blume, **C3.** *Zeuxine reflexa* King & Pantl., **C4.** *Zeuxine seetharamii* sp. nova., Lateral view of flower and bract **D1.** *Zeuxine longilabris* Trimen, **D2.** *Zeuxine gracilis* (Breda) Blume, **D3.** *Zeuxine reflexa* King & Pantl., **D4.** *Zeuxine seetharamii* sp. nova. (Photos by Shreyas Betageri).

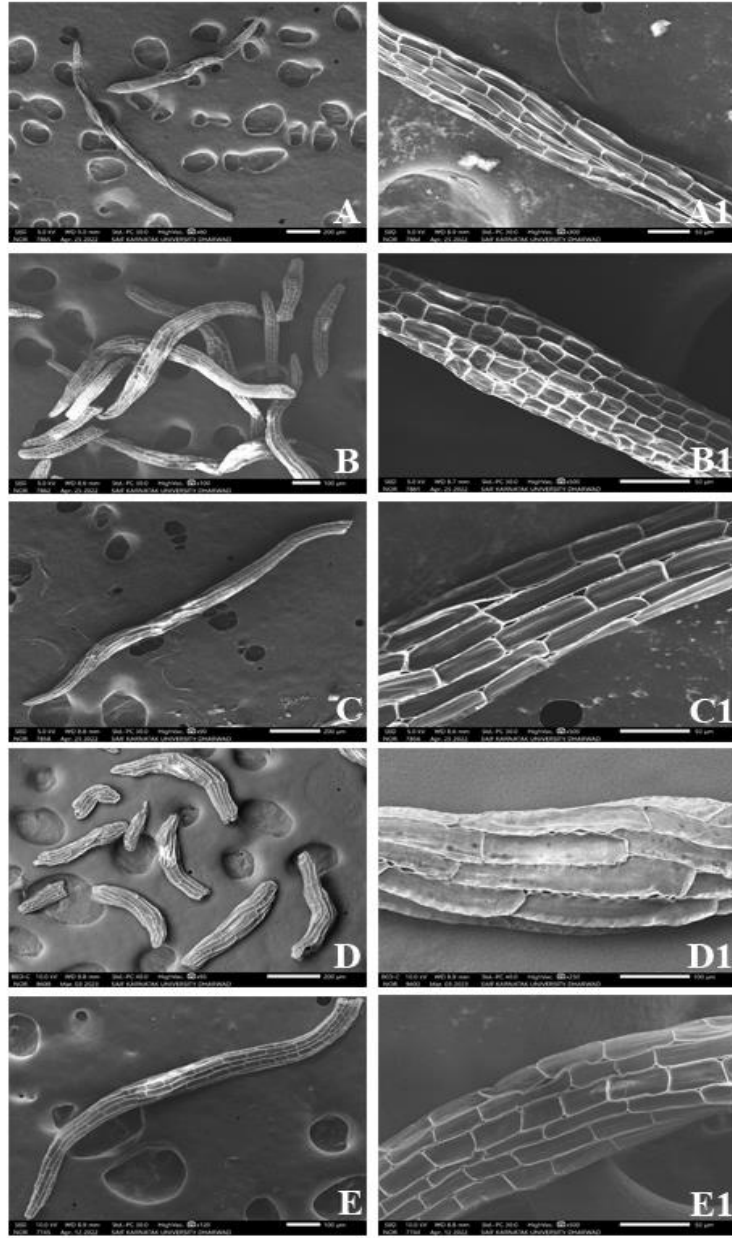
**Commented [s14]:** What about the altitude of the all the mentioned Zeuxine species.

**Commented [s15]:** Did the authors collect all the mentioned Zeuxine species from the same habitat or different habitats?

**Commented [s16R15]:** If authors collected all these Zeuxine species from different habitats, why the locations are not mentioned in the manuscript



**Fig. 4. Comparative account of Labellum, Pollinarium & Ovary of *Zeuxine* species in Karnataka:** **A. F. K.** *Zeuxine gracilis* (Breda) Blume, **A.** Dorsal view of labellum. **F.** Pollinarium. **K.** Ovary. **B. G. L.** *Zeuxine longilabris* Trimen, **B.** Dorsal view of labellum. **G.** Pollinarium. **L.** Ovary. **C. H. M.** *Zeuxine reflexa* King & Pantl., **C.** Dorsal view of labellum. **H.** Pollinarium. **M.** Ovary. **D. I. N.** *Zeuxine strateumatica* (L.) Schltr. **D.** Dorsal view of labellum. **I.** Pollinarium. **N.** Ovary. **E. J. O.** *Zeuxine seetharamii* sp. nova. **E.** Dorsal view of labellum. **J.** Pollinarium. **O.** Ovary. (Photos by Shreyas Betageri).

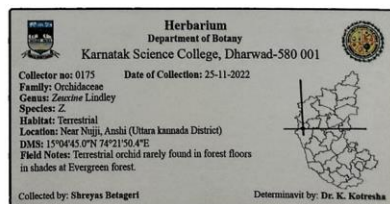


**Fig. 5.** Seed morphometric variations in *Zeuxine* species of Karnataka: **A. A1.** *Z. gracilis*; **B. B1.** *Z. longilabris*; **C. C1.** *Z. reflexa*; **D. D1.** *Z. straetumatica*; **E. E1.** *Z. seetharamii* sp. nov.

**Commented [s17]:** What variations are observed in seed structures. The authors should indicate the variations with the help of arrows in the figure

**Commented [s18]:** Did the authors collect seeds from Same habitat?

**Commented [s19]:** Where is the methodology of Seed Morphometry?  
Instrument name, how seeds are prepared for SEM analysis.



**Fig. 6:** Herbarium specimen of *Zeuxine seetharamii* sp. nov.

**Commented [s20]:** Authors should replace the photograph with the original Herbarium sheet photo. Modifying of the photo is strictly prohibited