

Lesser known orchids of Himachal Pradesh: I. Genus *Zeuxine* Lindley

Jagdeep Verma¹, Kusum², Kranti Thakur² and S. P. Vij

Department of Botany, Panjab University, Chandigarh – 160014, Chandigarh, India

¹Author for correspondence: Department of Botany, Shoolini Institute of Life Sciences & Business Management, Solan - 173212, Himachal Pradesh, India [E-mail: verma.jd@gmail.com]

²Department of Botany, Shoolini University of Biotechnology & Management Sciences, Solan - 173212, Himachal Pradesh, India

[Received 25.11.2013; Revised 05.05.2014; Accepted 18.05.2014; Published 30.06.2014]

Abstract

Zeuxine Lindley (Orchidaceae) is represented by two species, *Z. membranacea* Lindley and *Z. strateumatica* (Linnaeus) Schlechter, in Himachal Pradesh, northwest Himalaya. These are sympatrically distributed in the Himalayan foot hills and adjoining plains below an altitude of 1000 m. *Z. strateumatica* is a highly polymorphic taxon and critical examination of the different specimens revealed occurrence of three different morphotypes under this species complex. One of these seems to be an intermediate between *Z. membranacea* and *Z. strateumatica* that might be a natural hybridization product between the two. Both species are described in detail based on fresh collections made from the state. Notes are provided on their habitat characteristics, leaf epidermal features, distribution, and flowering and fruiting periods. Sand and boulder mining, and grazing in and around riverbeds are the major threats for these orchids in the state; immediate conservation measures are required to save their natural populations from further shrinkage.

Key words: Himachal Pradesh, *Zeuxine membranacea*, *Zeuxine strateumatica*, conservation

INTRODUCTION

Himachal Pradesh is a north Indian state located in northwest Himalaya (30° 22' to 33° 12' N latitude, 75° 47' to 79° 04' E longitude). Vast geographical expanse (55672 km²) and remarkable altitudinal variations (350 – 7000 m) have resulted in profuse accumulation of various phyto-elements here, and orchids are also represented by 85 species (Vij *et al* 2013) in the state. Many of these species possess ornamentally significant characteristics and/ or therapeutic properties. Some of the most fascinating orchid species of Himachal Pradesh belong to genera *Cypripedium* (the lady slippers), *Aerides* and *Rhynchostylis* (the fox-tails), *Goodyera* (jewel orchids), *Dactylorhiza* (marsh orchids), *Habenaria*, *Eulophia* and *Vanda*. However, there are many others (species of *Androcorys*, *Galearis*, *Pachystoma*, *Ponerorchis*, *Zeuxine*, etc.) that are not of much direct importance to man, and are therefore of little interest for horticulturists and herbalists. Current communication presents notes on taxonomy, leaf epidermal features, habitat characteristics, distribution and conservation of one such lesser known orchid genus, *Zeuxine*. There was no report of its occurrence in the state (Collett 1902; Duthie 1906; Nair 1977; Vij *et al* 1982; Chowdhery & Wadhwa 1984; Deva & Naithani 1986; Dhaliwal & Sharma 1999) before Kaur & Sharma (2004) who reported *Zeuxine strateumatica* from Sirmaur district. *Z. membranacea* has recently been recorded by Vij *et al* (2013).

MATERIALS AND METHODS

Present results are based on the collections made by the authors from Himachal Pradesh during years 2002 – 2011. Repeated field surveys were organized in the state during different seasons of the year. Plants were described based on fresh material, and the species identified following standard Flora (Duthie 1906; Deva & Naithani 1986). Information on habitat characteristics, flowering and fruiting periods, and threats to natural populations was collected during field observations. Leaf epidermal features (size and shape of epidermal cells; presence/absence of trichomes; organization, distribution frequency and index of stomatal complex) were also studied. For this purpose, fresh leaves were segmented and kept in 8 % KOH solution for 16 – 20 hrs. The dermal peels from both the abaxial and adaxial leaf surfaces were gently removed and stained with safranin prior to microscopic examination. The cellular measurements were done using stage and ocular micrometers, and stomatal types identified following Rasmussen (1987). Stomatal frequency was determined by calculating the average number of stomata per mm² leaf surface area. The stomatal index was calculated using following formula:

$$i = \frac{S}{S + E} \times 100$$

where i = stomatal index; S = total number of stomata in a given area of leaf, and E = total number of epidermal cells in the same area of leaf.

RESULTS

Zeuxine Lindley is represented by two species, *Z. membranacea* Lindley and *Z. strateumatica* (Linnaeus) Schlechter, in Himachal Pradesh. These are sympatrically distributed in the Himalayan foot hills and adjoining plains below an altitude of 1000 m. In what follows, the genus and its species are described. Notes are provided on habitat characteristics, leaf epidermal features, flowering and fruiting periods, distribution and threats to natural populations of both species.

***Zeuxine* Lindley**, Coll. Bot., App.:1. 1826, *nom. cons.* Type: *Zeuxine sulcata* (Roxburgh) Lindley

Terrestrial. Stem with creeping rhizome below, slender, leafy, fleshy. Roots arising at nodes. Leaves sessile, on a broad sheath or petiolate, often membranous. Inflorescence terminal spikes or racemes, erect, few to many, lax or dense flowered. Flowers small, scarcely opening. Sepals subequal, the dorsal erect, concave, forming hood with the petals, the laterals free. Petals narrower than sepals. Lip sessile, cymbiform or with a saccate base not produced beyond the lateral sepals, the sac usually containing 1 or 2 slender, papillar glands on each side, more or less contracted in the middle, dilated at apex into a small entire or wing like terminal lobe. Column short, often with winged lamellar or conical appendages in front, without foot. Pollinia 2, pyriform, with or without a caudicle. Fruit capsule, small, erect, ovoid.

The genus derives its name from Greek word *Zeuxis* (yoking) in reference to partially united lip and column of flower. It comprises of about 80 species extending from tropical Africa and Madagascar through India and Malaysia to Samoa and Fiji islands in the Pacific (Bose *et al* 1999). Out of eight species recorded from India (Sathish Kumar & Manilal 1994), three are reported to occur in Northwest Himalaya (Deva & Naithani 1986). Two species, *Z. membranacea* and *Z. strateumatica* are met in the state of Himachal Pradesh.

Key to species

1. Flowers cleistogamous; lip membranous, with minute side lobes at apex, without any callus projections in its basal part, white *Z. membranacea*
- 1a. Flowers chasmogamous; lip fleshy yellow or membranous, with fleshy yellow lobes in apical portion, with callus projections on either side in its basal part *Z. strateumatica*

***Zeuxine membranacea* Lindley**, Gen. Sp. Orchid. Pl. 486. 1840. *Tripleura pallida* Lindley, Gen. Sp. Orchid. Pl. 452. 1840. *Zeuxine tripleura* Lindley, J. Proc. Linn. Soc., Bot. 1: 186. 1857. *nom. superfl.* *Zeuxine godefroyi* H.G. Reichenbach, Otia Bot. Hamburg. 34. 1878. *Zeuxine evrardii* Gagnepain, Bull. Mus. Natl. Hist. Nat., II, 3: 326. 1931. *Zeuxine debrajiana* Sud. Chowdhury, Indian Forester 122: 87. 1996. **Figs. 1a, 2a-f.**

Terrestrial, rhizomatous, grass like herbs. Stem glabrous, stout or slender, 4 – 15 cm long, *ca* 2 mm thick. Roots fleshy, *ca* 1.5 mm thick. Leaves 3-6, sessile, erect, clasping the stem, linear, acuminate, 2 – 5 × 0.4 – 0.5 cm, with stout midrib, margins recurved. Inflorescence terminal racemes, 2 – 5 cm long, with many, densely arranged flowers. Floral bracts ovate-lanceolate, acuminate, 10 – 15 × 5 – 5.5 mm, with a small projection on one side near the base, longer than ovary. Flowers white, with lip of same colour, *ca* 8 mm long. Sepals subequal, 4 – 4.5 × 1.5 – 2 mm; the dorsal ovate, acute; the laterals lanceolate, obtuse, connivent. Petals obliquely oblanceolate, obtuse, about as long as sepals, *ca* 4 × 1.5 – 2 mm. Lip membranous, not fleshy, *ca* 4 mm long, 2 – 2.5 mm broad at the base, smooth on inner surface without any teeth-like structure, 3-veined with side ones not reaching the tip; apex with 2 short or minute lobes, entire. Column very short, with two wings at its apex covering the anther. Pollinia 2, clavate, stipe hyaline, thin and slender, viscidium minute, oblong-ovate. Fruit capsule, ellipsoid, strongly ribbed, 9 – 12 × 4 – 5 mm.

Etymology: The species epithet *membranacea* (Latin: membranous) refers to the thin and semi transparent nature of lip (“labello membranaceo apice oblato, apiculato”).

Flowers & Fruits: January – April.

Leaf Epidermis: Leaves hypostomatic, trichomes absent. Epidermal cells polygonal, 100.15 × 61.63 µm on abaxial and 148.94 × 100.58 µm on adaxial surface, with non-sinuuous walls. Stomata oval, diacytic and anomocytic; guard cells longitudinally placed, measuring 44.5 × 39.37 µm, pore size 18.4 × 1.28 µm; stomatal frequency 19.0; stomatal index 8.42.

Habitat: Grows on more or less sandy soils in tropical and subtropical regions upto an altitude of 800 m in exposed and grassy situations as isolated individual plants or in groups of 2 – 4 plants. *Imperata cylindrica* (Linnaeus) P. Beauvois, *Saccharum bengalense* Retzius and *Equisetum debile* Roxburgh *ex* Vaucher are its close associates. *Eulophia dabia* (D. Don) Hochreutiner and *Zeuxine strateumatica* (Linnaeus) Schlechter often share the habitat.

Local distribution: Jhalera in Una dist. Recently reported for the state flora (Vij *et al* 2013).

Specimen cited: Jhalera in Una district, Vij & Verma 125 (PAN).

Distribution: India (Chandigarh, Himachal Pradesh, Punjab, Bihar, Maharashtra, Eastern Himalayan parts), China, Hong Kong, Papua New Guinea.

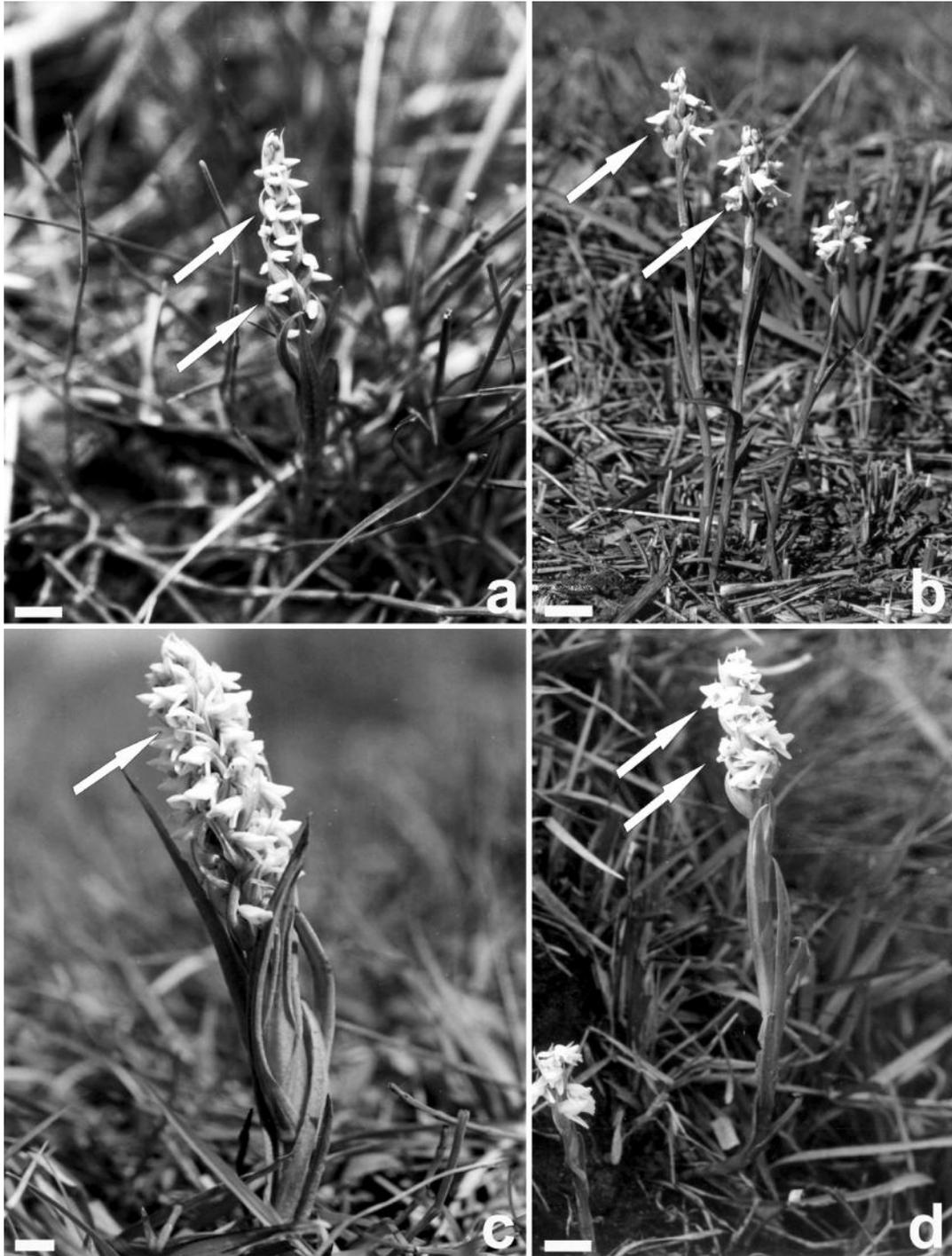


Fig. 1a-d: Genus *Zeuxine* Lindley (Orchidaceae) in Himachal Pradesh: a. *Zeuxine membranacea* Lindley in natural habitat (note cleistogamous flowers); b-d. Three Morphotypes of *Zeuxine strateumatica* (Linnaeus) Schlechter in the field: b. Morphotype I; c. Morphotype II; d. Morphotype III. [Scale bars = 1 cm]

***Zeuxine strateumatica* (Linnaeus) Schlechter**, Bot. Jahrb. Syst. 45: 394. 1911; Nair, Rec. Bot. Surv. India 21 (1): 247. 1978; Seidenfaden, Dansk Bot. Ark. 32 (2):79. t. 48. 1978; Sharma & Bir, Fl. Patiala 164. 1978; Sharma & Kachroo, Fl. Jammu & Pl. Neigh. 298. 1981; Seidenfaden & Arora, Nord. J. Bot. 2: 26. 1982; Deva & Naithani, Orch. Fl. N.W. Himal. 99. t. 45. 1986; Sharma & Vij, Orchid News 3: 9. 1987; Jain *et al*, Fl. Haryana 200. 2000; Kumar, Fl. Haryana 363. 2001; Kaur & Sharma, Fl. Sirmaur 601. 2004. *Orchis strateumatica* Linnaeus, Sp. Pl. 943. 1753. *Neottia strateumatica* (Linnaeus) R. Brown, Prodr. Fl. Nov. Holl. 319. 1810. *Spiranthes strateumatica* (Linnaeus) Lindley, Bot. Reg. 10: t. 823. 1824. *Pterygodium sulcatum* Roxburgh, Fl. Ind. ed. 2. 3: 452. 1832. *Zeuxine sulcata* (Roxburgh) Lindley in Royle, III. Him. Bot. 1: 368. 1839 *et* Gen. Sp. Orchid. Pl. 485. 1840; Hooker *f.*, Fl. Brit. India 6: 106. 1890; King & Pantling, Ann. Roy. Bot. Gard. (Calcutta) 8: 286. t. 381. 1898; Duthie, Ann. Roy. Bot. Gard. (Calcutta) 9: 168. 1906. *Zeuxine robusta* Wight, Icon. Pl. Ind. Orient. 5: t. 1726. 1851. *Adenostylis strateumatica* (Linnaeus) Ames, Orchidaceae 2: 58. 1908. *Adenostylis sulcata* (Roxburgh) Hayata, Icon. Pl. Formosan. 6 (Suppl.): 75. 1917. *Zeuxine strateumatica* var. *rupicola* (Fukuyama) S. S. Ying, Col. Ill. Indig. Orch. Taiwan 1(2): 512. 1977. *Zeuxine strateumatica* f. *rupicola* (Fukuyama) T. Hashimoto, Ann. Tsukuba Bot. Gard. 5: 27. 1986. *Zeuxine strateumatica* var. *laxiflora* I. Barua, Orchid Fl. Kamrup Distr. Assam: 52. 2001. **Figs. 1b-d, 2g-u.**

Terrestrial, rhizomatous, grass like herbs. Rhizome short. Stem erect or ascending, pale brown, with several to many leaves. Stem glabrous, stout or slender, 5-25 cm long, *ca* 2 mm thick. Roots fleshy, *ca* 1.5 mm thick. Leaves 3-6, sessile, erect, linear, acuminate, 2-7 × 0.4-0.6 cm, with stout midrib, margins recurved. Inflorescence terminal racemes, 1.5-6 cm long, many, laxly or densely arranged flowers. Floral bracts ovate-lanceolate, acuminate, 10-14 × 3-4 mm, longer than ovary. Flowers greenish-white, with yellow lip, *ca* 10 mm long. Sepals unequal, 5-7 × 2-3 mm; the dorsal ovate, concave; the laterals obliquely lanceolate, obtuse, connivent. Petals obliquely oblong, obtuse, *ca* 6 × 2 mm, forming hood with dorsal sepal. Lip yellow, as long as sepals, cymbiform and saccate at the base, bearing inside the sac two inward-pointing teeth and two narrow lamellae united at the midrib, terminal lobe short, subquadrate, entire or bifid. Column very short, with two wings at its apex covering the anther. Pollinia 2, clavate, stipe hyaline, thin and slender, viscidium oblong-ovate. Fruit capsule, ellipsoid, strongly ribbed, 10-12 × 4-5 mm.

Etymology: The species epithet *strateumatica* (Latin: occurring in fields, standing stalwart like soldiers) refers to its occurrence in clumps in fields.

Flowers & Fruits: January – April

Habitat: All the morphotypes grow mixed in tropical – subtropical climates (upto 1000 m) in exposed and grassy vegetation as individual plants or in groups of 5 – 10 plants. The plants are associated with *Imperata cylindrica*, *Saccharum bengalense* and *Equisetum debile* in more or less sandy soils on open riverbed and along the banks of seasonal water channels. *Eulophia dabia* often shares the habitat.

Local distribution: Jhalera in Una, Karsog, near Dimki temple river bed (Nahan).

Voucher specimen: Jhalera in Una district, Vij & Verma 133, 143 (PAN); Karsog, Srivastava & party 772024 (BSD).

Distribution: Pakistan, Saudi Arabia, Afghanistan, India (Jammu & Kashmir to Arunachal Pradesh, Delhi, Punjab, Uttar Pradesh, Madhya Pradesh, Bihar, Jharkhand, West Bengal, Meghalaya, Assam, Mizoram, Tripura, Orissa, Tamil Nadu, Kerala, Karnataka, Maharashtra,

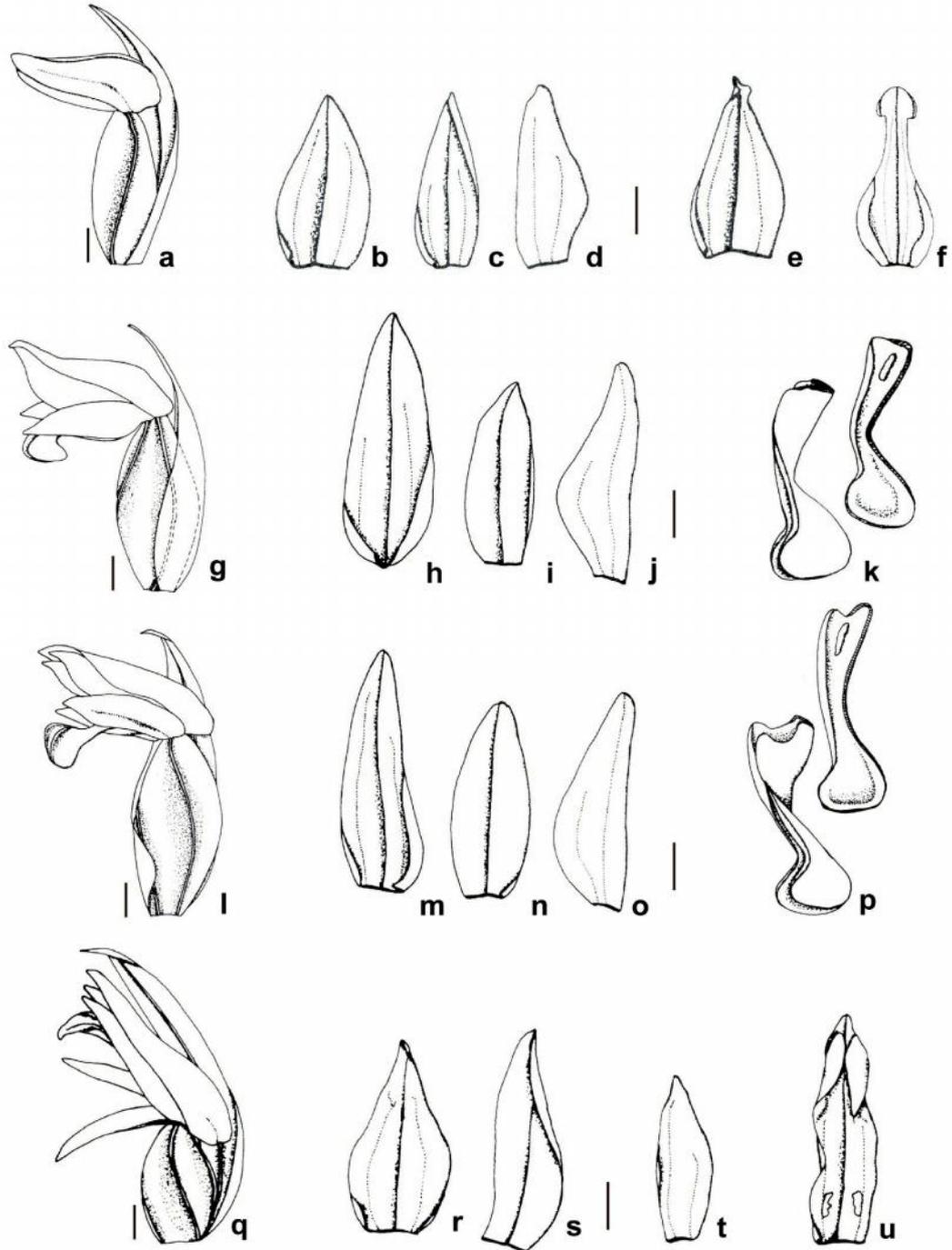


Fig. 2a-u: Floral details of *Zeuxine* Lindley species: a-f. *Zeuxine membranacea* Lindley: a. a flower (note cleistogamous nature); b. dorsal sepal; c. lateral sepal; d. petal; e - f. lip; g - k. Morphotype I of *Zeuxine strateumatica* (Linnaeus) Schlechter: g. a flower; h. dorsal sepal; i. lateral sepal; j. petal; k. lip (whole and dissected); l - p. Morphotype II: l. a flower; m. dorsal sepal; n. lateral sepal; o. petal; p. lip (whole and dissected); q - u. Morphotype III: q. a flower; r. dorsal sepal; s. lateral sepal; t. petal; u. lip (note membranous nature). [Scale bars = 1 mm]

Gujarat, Rajasthan), Nepal, Bhutan, Bangladesh, Sri Lanka, Myanmar, China, Thailand, Malaysia, Japan, Philippines, Indonesia, Papua New Guinea.

Note: It is a quite polymorphic species. Critical examination of the different specimens revealed the occurrence of three different morphotypes under this species complex. Two of these bear fleshy yellow lip. The third one, however, bear white membranous lip but with fleshy yellow apical lobes. This morphotype seems to be an intermediate between *Z. membranacea* (white membranous lip with poorly developed lateral lobes) and *Z. strateumatica* (chasmogamous flowers, lip with yellow somewhat fleshy lateral lobes, presence of callus at lip base) that might have produced due to random hybridization between the two. Gross morphological variations and leaf epidermal features of all these 3 morphotypes are given here.

A. Morphotype I: Slender plants with thin stem bearing longer internodes; leaves spreading or rarely stem-clasping, green or greenish-rust coloured, rarely reaching upto the base of inflorescence; flowers chasmogamous; lip fleshy, yellow. The morphotype is common and usually grows on grassy plots. **Figs. 1b, 2g-k.**

Leaf Epidermis: Leaves hypostomatic, trichomes absent. Epidermal cells polygonal, $136.09 \times 76.83 \text{ }\mu\text{m}$ on abaxial and $180.17 \times 131.67 \text{ }\mu\text{m}$ on adaxial surface, with non-sinuuous walls. Stomata oval, diacytic and anomocytic; guard cells longitudinally placed, measuring $63.65 \times 48.72 \text{ }\mu\text{m}$, pore size $20.73 \times 1.28 \text{ }\mu\text{m}$; stomatal frequency 23.6; stomatal index 8.7.

B. Morphotype II: Robust plants with stout stems bearing smaller internodes; stem clasping leaves usually rust coloured, overtopping the inflorescence; flowers chasmogamous; lip fleshy, yellow. **Fig. 1c, 2l-p.**

Leaf Epidermis: Leaves hypostomatic, trichomes absent. Epidermal cells polygonal, $142.09 \times 80.03 \text{ }\mu\text{m}$ on abaxial and $189.17 \times 119.84 \text{ }\mu\text{m}$ on adaxial surface, with non-sinuuous walls. Stomata oval, diacytic and anomocytic; guard cells longitudinally placed, measuring $59.92 \times 44.94 \text{ }\mu\text{m}$, pore size $23.5 \times 1.28 \text{ }\mu\text{m}$; stomatal frequency 26.3; stomatal index 9.9.

C. Morphotype III: Robust or slender plants with longer internodes; leaves usually rust coloured, reaching upto the base of inflorescence; flowers chasmogamous; lip not fleshy, white, bearing small, fleshy, yellow side lobes at apex. **Figs. 1d, 2q-u.**

Leaf Epidermis: Leaves hypostomatic, trichomes absent. Epidermal cells polygonal, $123.83 \times 73.03 \text{ }\mu\text{m}$ on abaxial and $138.73 \times 128.65 \text{ }\mu\text{m}$ on adaxial surface, with non-sinuuous walls. Stomata oval, diacytic and anomocytic; guard cells longitudinally placed, measuring $53.06 \times 42.54 \text{ }\mu\text{m}$, pore size $18.4 \times 1.28 \text{ }\mu\text{m}$; stomatal frequency 21.7; stomatal index 8.24.

DISCUSSION

Zeuxine membranacea is quite similar in vegetative morphology to *Z. strateumatica* but can be differentiated by its cleistogamous flowers. The lip is membranous and white (just like its other perianth segments), and never fleshy and yellow (as in *Z. strateumatica*). Inner surface of lip is smooth, without any callus at the basal portion. Apical lobes of lip are short or minute in contrast to the prominent thick lobes in *Z. strateumatica*, and sepals and petals are also comparatively shorter. Santapau & Kapadia (1966), described this taxon within *Z. strateumatica*; Haines (1924), and Blatter & McCann (1931-1932) treated it as a separate species based on its smaller sepal size and minute terminal lobes of the lip.

Loss, fragmentation and degradation of habitat due to sand and boulder mining are the main threats to natural populations of *Zeuxine* spp. in Himachal Pradesh. Orchids are inherently

slow growers and are very sensitive to such environmental degradation. As orchid seeds cannot germinate without an appropriate fungal stimulus in nature, it is necessary that the soils should also be favorable for growth of their mycorrhizal partner. Degradation of soils, and changes in land use patterns are altering above- and below-ground biodiversity in various habitats. The overgrazed and mining areas are more prone to soil erosions; therefore same areas should not be used for these practices every year.

LITERATURE CITED

- Blatter, E. & McCann, C. 1931-1932. Revision of the flora of Bombay Presidency (Orchidaceae). *J. Bombay Nat. Hist. Soc.*, 35: 13 – 31.
- Bose, T.K.; Bhattacharjee, S.K.; Das, P. & Basak, U. 1999. *Orchids of India*. Naya Prokash, Calcutta.
- Chowdhery, H.J. & Wadhwa, B.M. 1984. *Flora of Himachal Pradesh*, vol. 3. Botanical Survey of India, Calcutta.
- Collett, H. 1902. *Flora Simlnensis*. Thacker, Spink and Co., Simla.
- Deva, S. & Naithani, H.B. 1986. *The Orchid Flora of North West Himalaya*. Print and Media Associates, New Delhi.
- Dhaliwal, D.S. & Sharma, M. 1999. *Flora of Kullu District (Himachal Pradesh)*. Bishan Singh Mahendra Pal Singh, Dehradun.
- Duthie, J.F. 1906. The Orchids of North-Western Himalaya. *Ann. Roy. Bot. Gard. Calcutta*, 9: 81 – 211.
- Haines, H.H. 1924. *The Botany of Bihar and Orissa*. Orchidaceae, 6: 1150 – 1182. Adlard, London.
- Kaur, H. & Sharma, M. 2004. *Flora of Sirmour (Himachal Pradesh)*. Bishan Singh Mahendra Pal Singh, Dehradun.
- Nair, N.C. 1977. *Flora of Bashahr Himalayas*. International Bioscience Publishers, Hissar.
- Rasmussen, H. 1987. Orchid stomata structure, differentiation, function and phylogeny. In J. Arditti (ed.), *Orchid Biology Reviews and Perspectives*, vol. IV. Cornell Univ. Press, Ithaca, New York. Pp. 105 – 138.
- Santapau, H. & Z. Kapadia. 1966. *The Orchids of Bombay*. Govt. of India Press, Calcutta.
- Sathish Kumar, C. & Manilal, K. S. 1994. *A Catalogue of Indian Orchids*. Bishan Singh Mahendra Pal Singh, Dehradun.
- Vij, S.P.; Toor, I.S.; & Skekhar, N. 1982. Observation on the orchidaceous flora of Simla and adjacent hills in the NW Himalayas (ecology and distribution). *Res. Bull. (Sci.) Panjab Univ.*, 33 (3, 4): 163 – 175.
- Vij, S.P.; Verma, J. & Sathish Kumar, C. 2013. *Orchids of Himachal Pradesh*. Bishan Singh Mahendra Pal Singh, Dehradun.