

Evaluation of physicochemical property and fatty acid composition of *Opuntia elatior* seed oil

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Abstract

Seed oil extracted from *Opuntia elatior* was analyzed for its physicochemical properties such as acid value, iodine value, saponification value, unsaponifiable matter and fatty acid composition. The assessment of fatty acid composition using gas liquid chromatography shows the presence of 15.65% saturated fatty acids and 84.35% unsaturated fatty acids. Linoleic acid was the dominating fatty acid followed by oleic and palmitic acids respectively. The oil analysis showed that the Iodine value, Acid value, Saponification value and Unsaponifiable matter were 110.95, 1.64, 191.85 and 2.65 respectively. *Opuntia elatior* appears to be a good potential source of seed oil for industrial utilization.

Keywords: seed oil; fatty acids; physicochemical characteristics.

Introduction

Opuntia elatior is a member of the Cactaceae family. The fruit is an oval, elongated berry, consisting of a thick pericarp with a number of clefts of small prickles, dark reddish in colour, with a luscious sweet pulp intermixed with many small hard seeds. The ripe fruits of *Opuntia* sp. are 30-220 g in weight contain pulp (39-67 %), seeds (10-15 %) and peel (31-51 %). Many authors have studied the traditional uses of *Opuntia* sp. (Kirtikar and Basu, 1999; The Wealth of India, 2001; Duke and Vasquez, 1994; Galt and Galt, 1978; Barbera *et al.*, 1992). Major studies have been done on the phytoconstituents of *Opuntia* sp. (Retamal *et al.*, 1987; Rodriguez-Felix and Cantwell, 1988; Batista *et al.*, 2003). Kossori *et al.* (1998) reported mineral composition of *O. ficus-indica* seeds along with protein content. Nassar (2008) studied amino acids composition of prickly pear seed flour and its protein concentrate. Other authors have studied the nutritional significance of *Opuntia* sp. (Stintzing *et al.*, 2001; Piga, 2004; Stintzing and Carle, 2005; Feugang *et al.*, 2006). A remarkable number of studies have been reported on ethnopharmacological actions of *Opuntia* sp. such as Analgesic and Anti-inflammatory (Park *et al.*, 2001; Loro *et al.*, 1999), anticancer (Sreekanth *et al.*, 2007), antidiabetic (Domínguez-López, 1995; Cicero *et al.*, 2004; Frati *et al.*, 1989a, 1989b, 1990a, 1991; Roman-Romas *et al.*, 1991, 1995; Ibanez-Camacho *et al.*, 1979, 1983; Frati *et al.*, 1988, 1990b; Trejo-González *et al.*, 1996; Gonzalez *et al.*, 1996), Anti-hyperlipidemic & Hypercholesterolemic (Fernandez *et al.*, 1992; Frati, 1992; Gurbachan and Felker, 1998; Galati *et al.*, 2003; Jones *et al.*, 2000), Antioxidant (Tesoriere *et al.*, 2002, 2003, 2004, 2005a, 2005b; Stintzing *et al.*, 2005; Zourgui *et al.*, 2008), Antiulcer (Galati *et al.*, 2001, 2002a), antiviral (Ahmad *et al.*, 1996; Mtambo *et al.*, 1999), Diuretics (Galati *et al.*, 2002b), Immunomodulatory (Schepetkin *et al.*, 2008), improving platelet function (Wolfram *et al.*, 2003), Neuroprotective (Jungsook Cho *et al.*, 2003; Jung-Hoon Kima *et al.*, 2006), and Antispermatic (Gupta *et al.*, 2002). Prickly pear seeds were first characterized (Sawaya *et al.*, 1983) and showed that the seeds of *Opuntia ficus-indica* are rich in minerals and sulphur amino acids. A reserve protein from the seeds has been isolated and characterized (Uchoa *et al.*, 1998).

The prickly pear seed oil composition and its chemical characteristics were investigated (Sawaya and Khan, 1982; Salvo *et al.*, 2002). Monitoring of seed composition of prickly pear fruits during maturation period

(Coskuner & Tekin, 2003). However, studies on the physicochemical characteristics and fatty acid composition of seed oil of *O. elatior* are up to now unknown.

The majority of the products use the juice of the cactus pear, while the seeds are usually discarded. The ratio of low water requirement and high water-use efficiency supports the expansion of cactus production, as stated by the Food and Agriculture Organisation (Barbera *et al.*, 1995). Annual production of prickly pear can reach 50 tons/hectare under most favourable condition (Dominguez-Lopez, A., 1995). Therefore, *Opuntia* will be a significant fruit crop for revitalization in arid and semiarid areas. Seeds constitute about 10-15% of the edible pulp and are usually discarded as waste after extraction of the pulp. Oil from the seeds of *O. ficus-indica* constitutes 8-12% of whole seed weight and is characterised by a high degree of linoleic acid (Sawaya & Khan, 1982; Pimienta-Barrios, 1994; Stintzing *et al.*, 2000). Moreover, no data about the seed is yet available. In the present study, we analysed the seeds to obtain information about the physicochemical characteristics of seed and fatty acid composition of seed oil in *O. elatior* which will serve as a basis for further detailed chemical investigation and nutritional evaluation. The results will be important as an economic utility of cactus pear as a new source of seed oil. Being an organic natural plant *O. elatior* appears to be a good potential source of seed oil for industrial utilization.

Materials and methods

Sampling

O. elatior is declared as a noxious weed in semi-arid regions of Saurashtra (Gujarat) India. Fresh mature fruits were collected from the hedges of the plant in any field during the month of August, 2012. The specimen collected was identified with the help of Flora of the Indian Desert (Bhandari, 1995). After separating, the seeds were washed with distilled water several times and air-dried at ambient temperature.

Extraction and analysis of oil

O. elatior seeds were powdered without removing the testa and then extracted completely with petroleum ether (40-60 °C) in a Soxhlet apparatus for 6 - 8 hours. The thimble is taken out dried and the contents are finely ground in a mortar. The material is again transferred to the thimble and extraction is continued for one hour. The resulting extract was filtered and the solvent was evaporated using rota evaporator leaving behind yellowish oil. It was analysed for its various physicochemical properties by AOCS standard methods (Link., 1973).

Gas liquid chromatography (GLC) analysis of fatty acid methyl ester

The fatty acid analysis was carried out as per Bureau of Indian Standards (548, part III) testing procedures using a NUCON-GLC chromatograph with a flame ionization detector (FID). The column used was 30M x 0.53 mm I.D. 5.0 µm DB-1 Type MXT-1 capillary column. Sample injection was done at 60 °C and the temperature programming was set for 2 °C rise per minute till a maximum of 280 °C. The total run time was 40 min. Each fatty acid was identified by comparing its retention time with that of a Sigma-Aldrich standard fatty acids mixture.

Results and discussion

The major objective of the present work was to study the physicochemical properties of the seed oil and fatty acid composition of *O. elatior*, as presented in Table 1. Seed oil content in *O. elatior* was 13.6 %. According to the results obtained by Coskuner and Tekin (2003) in a study of *O. ficus-indica*, because the palmitic acid content is closer to ours (12 versus 12.18 %), but the content of linoleic acid is lower (52 versus 65.81 %). The observed difference is possibly due to the degree of maturity of the fruit; however, some authors have also suggested that there was an increase in saturated fatty acid content towards the end of fruit maturation. Linoleic acid is the major component (65.81 %), followed by oleic (16.88 %) and palmitic acids (12.18 %). Stearic and Eicosadienoc acids were detected in *O. elatior* seed oil in low amounts 3.47 % and 1.66 %, respectively.

The saponification value was 191.85, which indicates amount of saturated fatty acids in the oil, and the iodine value was 110.95. Acid value and unsaponifiable matter were 1.64 and 2.65 respectively. The ratio of saturated to unsaturated fatty acid was 15.65:84.35 %.

Table 1. Physicochemical characteristics and fatty acid composition of *Opuntia elatior* (Mill.) Willd. seed oil.

Characteristics	Results
Acid value	1.64
Iodine value	110.95
Saponification value	191.85
Unsaponifiable matter	2.65
Fatty acid	
C16:0 - Palmitic acid	12.18 %
C18:0 - Stearic acid	3.47 %
C18:1n9c - Oleic acid	16.88 %
C18:2n6c - Linoleic acid	65.81 %
C20:2 - Eicosadienoic acid	1.66 %

Conclusions

The oil analysis show that the iodine value and saponification value in *Opuntia elatior* was higher than *O. ficus-indica*. The Palmitic acid concentration in *O. elatior* was 12.18% while in *O. ficus-indica* it was 9.32%. Eicosadienoic acid (EDA) was found to be present only in *O. elatior*, and was not reported from *O. ficus-indica*. Thus the results obtained prove the presence of an essential Omega-6 fatty acid (EDA) which improves the economic utility of cactus pear as a potential source of seed oil.

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AERIDES RINGENS (LINDL.) C.E.C. FISCH: A NEW ADDITION TO THE ORCHID FLORA OF GUJARAT, INDIA

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Abstract

Aerides ringens (Lindl.) C.E.C. Fisch. (Orchidaceae) is an endemic species of Southern India. It was recorded for the first time from the South Gujarat. The brief description and photographic illustration are provided here to facilitate the identification.

Introduction

THE GENUS *Aerides* belonging to family Orchidaceae, subfamily Epidendroideae, tribe Vandeae, subtribe Aeridinae was described by Loureiro in 1790. The generic epithet (greek *aer* = air, *eides* = coming from) refers to the epiphytic growth habit, which was extraordinary for scientists in the eighteenth century (Kocyan *et al.*, 2008). It is a relatively small orchid genus which comprising of 21 species ranging from India to Papua New Guinea (Christenson 1993; Kocyan *et al.* 2008) with main centre of species diversity in mainland tropical Asia. Due to the fragrance, it is preferred as a source for the production of numerous artificial hybrids and cultivars. The first author has collected this specimen from Dharampur, Valsad district, Gujarat. After critical studies, it was identified as *A. ringens* (Lindl.) C.E.C. Fisch. following Cooke (1908) and Abraham and Vatsala (1981). The specimen was deposited at BARO herbaria of The Maharaja Sayajirao University of Baroda, Vadodara. After scrutiny of relevant literature (Bole and Pathak 1988; Reddy 1987; Shah 1978; Tadv, 2014), it was found that this species has not yet been recorded in Gujarat flora. Hence, the present communication reports the species as a new record for Gujarat State. A detailed description and photographs are provided for easy identification.

An identification key for the three species *A. ringens*, *A. maculosum* and *A. crispum* is provided below:

Flowers almost inodorous, pinkish - violet, sepals and petals spotted, midlobe of the lip broadly ovate, lateral lobes minute, spur pointing back and down.....*A. maculosum*

Flowers sweetly fragrant, white tinged with pink, sepals and petals not spotted, midlobe of the lip ovate-deltoid, lateral lobes few mm long, spur pointing forward, half the length of the lip.....*A. crispum*

Flowers white, flushed with pink, mid lobe of the lip fleshy, spur almost equal in length to the lip.. *A. ringens*

Species Description

Aerides ringens (Lindl.) C.E.C. Fisch.

Aerides ringens (Lindl.) C.E.C. Fisch., Kew Bull. 284, 1928 and Fl. Pres. Madras: 1442 (1008), 1928; Sant. and Kapad., Orch. Bombay: 119-20, 1966; *Saccolabium ringens* Lindl., Gen Sp. Orc. 221, 1833; Wt.lc. t. 917, 1844 45; *Saccolabium rubrum* Wt. lc. 5 (1) : 9, t. 1674, 1852; *Aerides lineare* Hook. F., Fl. Brit. India 6: 47, 1890.

Epiphytic. *Stem* 5-20 cm long, covered with sheaths of decayed leaves. *Leaves* coriaceous, 22-27 x 1-2 cm, linear-oblong with unequally bilobed apex, mottled with dark purple on both the surface. *Inflorescence* lax raceme, 1-6 per plant, longer or shorter than the leaves. Within one inflorescence 25 - 34 flowers. Distance between two flowers 0.3-0.4 cm. *Flowers* white flushed with pink in varying degrees, 1.7 x 1.4 cm. *Dorsal Sepal* 0.6 by 0.3 cm, elliptic, obtuse; two lateral sepal 0.6 x 0.5 cm, broadly elliptic or sub orbicular. *Lateral Petals* 0.6 x 0.35 cm, broadly elliptic, obtuse. *Lip* deflexed, 0.7 x 0.9 cm; side lobes minute with two fleshy calli on the disc; midlobe ovate; *Spur* 0.6 cm in length, cylindrical, obtuse, incurved. Caudicle of the *pollinia* short (Fig. 1a-e).

Flowering and Fruiting

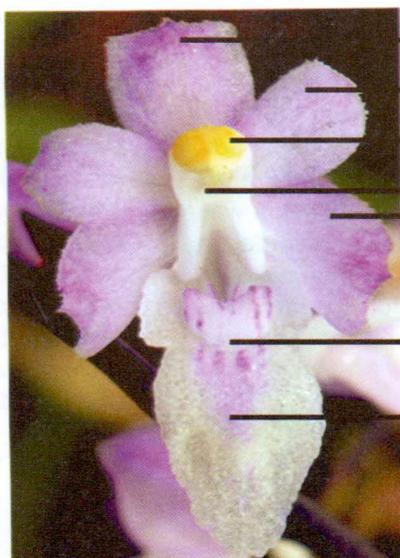
May-June

Locality

Dharampur taluka, Valsad district, Gujarat, 20°29'43.5''N, 073°24'50.8''E, elevation 830 ft.

Specimen Examined

MB 050, KEW K000891428, The Gray Herbarium



- DORSAL SEPAL
- LATERAL PETAL
- ANTHUR CAP
- COLUMN
- LATERAL SEPAL
- BASAL CALLI
- LABELLUM

Fig.1.a-e. *Aerides ringens* (Lindl.) C.E.C. Fisch.: a, Habit; b, Pollinia; c, Pollinia cap; d, Side view of flower; e, Front view of flower.

(GH), GH00103871.

Andaman islands (WCSP, 2014).

Distribution

Southern India (Kerala, Tamil Nadu), Sri Lanka and

Acknowledgement

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Gujarat Biodiversity Board for financial support during the present investigation. Authors are also thankful to Prof. S. K. Garge, Department of Botany, The Maharaja Sayajirao University Baroda for providing the laboratory facilities and Sh. D. Pandya, Dharampur, Valsad for his assistance during field work.

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HABENARIA FOLIOSA A. RICH. (ORCHIDACEAE) – A NEW RECORD FOR THE FLORA OF SAURASHTRA, GUJARAT

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ABSTARCT

Habenaria foliosa A.Rich. belonging to family of Orchidaceae is recorded for the first time from Saurashtra. The complete description and photographic illustration of the specimen is provided here for its easy identification.

INTRODUCTION

Flora of Saurashtra comprises of 1,172 angiosperms belonging to 132 families, of which 899 dicotyledons and 269 are monocotyledons (Santapau, 1962; Santapau & Janardhanan, 1966; Bole and Pathak, 1988; Nagar, 2000). Monocotyledons are mainly represented by Poaceae and Cyperaceae, while Orchidaceae is poorly represented. Orchidaceae is represented by only 2 species of the 32 species recorded from Gujarat (Shah 1978; Anonymous, 1996). However, *Habenaria foliosa* A.Rich. has not been recorded in flora of Saurashtra (Thaker, 1910; Santapau & Raizada, 1954; Santapau, 1962; Santapau and Janardhanan, 1966; Bole; Pathak, 1988; Nagar, 2005). *H. foliosa* was collected in August 2014 from Dattar hills, Junagadh. The collected plant material was identified from Cooke (1901). The

herbarium specimen was deposited at BSJO, Botanical Survey of India, Jodhpur and BARO, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat. A detailed description and photographs are provided here for its easy identification.

Habenaria foliosa A.Rich. Ann. Sci. Nat., Bot. II, 15: 71 1841; *H. gibsonii* Hook.f., Fl. Brit. Ind. 6: 135. 1890; Santapau & Kapadia in J. Bombay Nat. Hist. Soc. 56: 194. 1959; *H. gibsonii* var. *foetida* Blatter & McCann in J. Bombay Nat. Hist. Soc. 36: 16. 1932; Santapau & Kapadia in J. Bomabay Nat. Hist. Soc. 56: 194. 1959; *H. digitata* var. *gibsonii* (Hook.f.) Fischer in Gamble, Fl. Pres. Madras 1459. 1928; *H. foliosa* A. Rich. var. *foetida* (Blatt. et McCann) Bennet in J. Econ. Tax. Bot. 5: 452. 1984; *H. foliosa* var. *gibsonii* (Hook.f.) Bennet. J. Econ. Tax. Bot. 5: 452. 1984. (Figure 1)

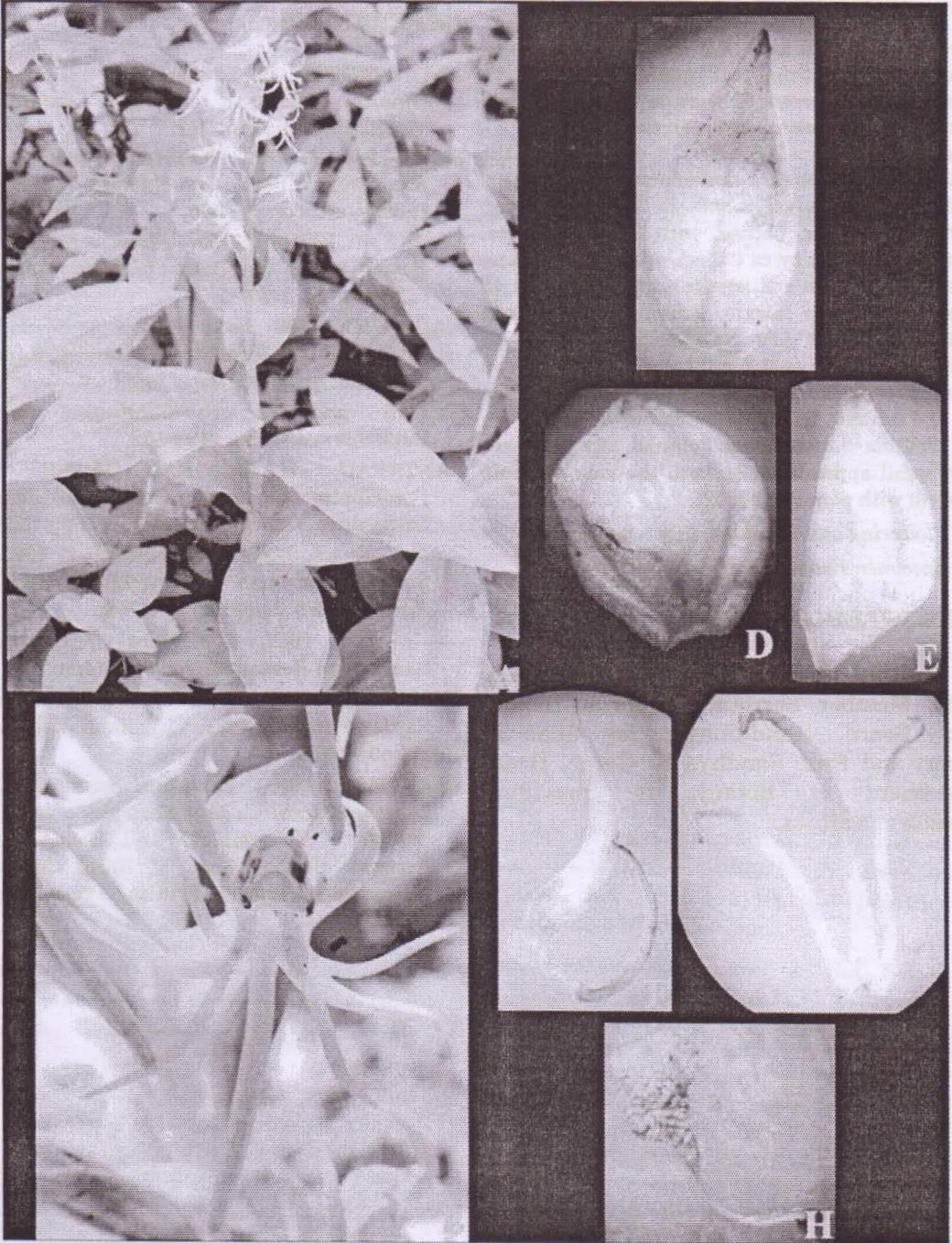


Fig. 1. *Habenaria digitata* Lindl.: A. Habit; B. Flower; C. Bract; D. Dorsal Sepal; E. Lateral Sepal; F. Lateral Petal; G. Lip; H. Single Polinarium

Annual tuberous herb of 45-50 cm height. Leaves ca 6.5 - 7.5 x 3 - 4.3 cm. alternate, ovate, acute, entire, sheathing leaf base. Inflorescence 8 - 10 cm long lax raceme, Flowers ca 2.5 - 3 cm long, greenish white; distance between two flower ca 0.8 - 1 cm; bract ca 2.5 - 2.7 x 0.9 - 1 cm equaling the length of ovary, foliar, lanceolate, acute; Sepals greenish-white; dorsal sepal ca 0.6 x 0.7 cm, greenish, orbicular, obtuse, with 3 main nerves; lateral sepal ca 1.1 by ca 0.6 cm, white, sub falcate, acute; Lateral petals 2 partite, upper segment ca 1.1 x 0.1 cm, sub falcate, acute; lower segment shorter ca 0.8 by 0.05 cm, linear, acute. Lip 3 partite middle one ca 1.3 x 0.1 cm, linear and two lateral ones 0.9 cm long, linear. Rostellum shorter than the column, triangular; Column ca 0.4-0.5 cm long; Pollinia 0.2 cm long; Pollinial cap possesses green small appendages on both the side, Capsule ca 2.4 cm with persistent bract.

Flowering and Fruiting: July - September

Specimen Examined: MB 38, MB 84,

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Extended distribution of *Geodorum laxiflorum* (Orchidaceae) in Gujarat, India^a

Mital R. Bhatt^{1*}, Jeewan S. Jalal² & Padamnabhi S. Nagar¹

Keywords/Mots-clés : endemic/endémique, Gujarat, new record/nouvel enregistrement, Western Ghats.

Abstract

Geodorum laxiflorum W.Griffith, an endemic species of India, is reported for the first time from Gujarat state as well as from the Western Ghats. A detailed description and photographs are provided for easy identification of the species. Information about its phenology, distribution, habitat, ecology and conservation status is provided. Besides a lectotype is designated for the species.

Résumé

Extension de la distribution géographique de *Geodorum laxiflorum* (Orchidaceae) à Gujarat (Inde) – *Geodorum laxiflorum* W.Griffith, espèce endémique d'Inde, est enregistrée pour la première fois dans l'État de Gujarat et dans les Western Ghats. Une description détaillée accompagnée de photographies est proposée pour faciliter l'identification de l'espèce. Des informations sur sa phénologie, sa distribution géographique, son habitat, son écologie et son statut de conservation sont également fournies. En outre un lectotype est désigné pour l'espèce.

Introduction

The genus *Geodorum* G.Jackson is an Indo-Malesian genus of about twelve species (Govaerts *et al.*, 2015). The generic name is derived from the Latin word *geo*, meaning 'earth', in reference to its habit. It is one of the most

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complicated genera within the Orchidaceae. Due to insufficient or lacking type material, the validity of the species has been questioned by Seidenfaden in his review of the genus (Seidenfaden, 1983). Although he did not manage to resolve all the problems, he accepted 31 species and called for a full monographic study. Pearce & Cribb (2002) suggested to accept 10 species for this genus.

These terrestrial orchids have sub-globose corms and few plicate leaves present during flowering but not yet fully developed. Inflorescence lateral, apically curved, usually shorter than leaves, laxly few to many flowered. However, to a large extent, various characters (such as scape shorter or longer than the leaves, raceme few or many flowered, lip shape, lip lobed or unlobed, ornamentation of the disc, whether smooth or keeled) have been relied upon to differentiate species. These characters overlap from one species to another up to such a degree that it is difficult to separate out these species.

In India the genus is represented by six species, namely *Geodorum appendiculatum* W.Griffith, *Geodorum densiflorum* (Lamarck) Schlechter, *Geodorum laxiflorum* W.Griffith, *Geodorum pallidum* D.Don, *Geodorum recurvum* (Roxburgh) A.Alston and *Geodorum attenuatum* W.Griffith. (Misra, 2007; Kumar *et al.*, 2008; Govaerts *et al.*, 2015).

During the orchid survey in Gujarat state the first author came across an interesting population of *Geodorum* in July, 2014 in Waghai taluka of the Dangs district. The district is located in the south-eastern part of the state and is part of the Western Ghats. The forests are mostly moist and deciduous vegetation. The average rainfall is 2000 mm, the rains commence in mid June and last until the end of October. At that time the *Geodorum* population was reported in vegetative stage. A year later (24 July, 2015) the first author revisited the locality and reported it in flowering stage. On critical observation and perusal of relevant literature (Seidenfaden, 1983; Hooker, 1890; Misra, 2007) it was identified as *Geodorum laxiflorum*. The perusal of relevant literature revealed that the species has hitherto not been reported from Gujarat (Suryanarayana, 1968; Desai, 1976; Shah, 1978; 1983; Vora, 1980; Reddy, 1987; Bole & Pathak, 1988; Tadvi, 2014) as well as from Western Ghats (Santapau & Kapadia, 1966; Abraham & Vatsala, 1981; Karthikeyan *et al.*, 1989; Satish Kumar & Manilal, 1994; Jalal & Jayanthi, 2012; Nayar *et al.*, 2014). Hence the present report is not only an extended distribution to the western part of India but also a new distribution record

for the Western Ghats. We present here the systematic treatment of this taxon along with a brief description, photographs, ecological notes and conservation status.

Systematic treatment

Geodorum laxiflorum W.Griffith, *Calcutta Journal of Natural History and Miscellany of the Arts and Sciences in India* 5: 356 (1845); J.D.Hooker, *Flora of British India* 6: 18 (1890); G.Seidenfaden, *Opera Botanica* 72: 51 (1983); S.Misra, *Orchids of Orissa*: 560 (2004).

Type: India, Assam, *sine loc.* Jenkins, *sine no.* ; material not found, probably not any longer existing. Drawing by Griffith in K, here designated as **lectotype**, in accordance with art. 9 of the Melbourne Code.

Plant terrestrial, 30-50 cm tall (including leaves); corm 4.5-5 cm, ovoid, slightly compressed, greenish brown, with scars of fallen leaves; roots few, vermiform, ca. 0.2 cm thick; pseudostem ca. 10 × 1 cm, enclosed by four foliar imbricating sheaths; leaves 2-4, cauline, alternate, elliptic lanceolate, acute, undulate, subequal, 13-36 × 8-12 cm, many veined, midvein prominent beneath; inflorescence lateral from the base of newly developed leafy shoot and shorter than it, 20-30 cm; peduncle erect, 20-27 × 0.2 cm, green, decurved at the top, with four membranous tubular sheaths; raceme laxly flowered with 6-12 medium sized flowers; rachis decurved, ca. 2.5-4 cm long with two sterile bracts; bracts green, oblong lanceolate, ca. 1.1 × 0.3 cm, membranous with acute apex, 3 veined; pedicel with ovary 1.3 cm long, ribbed; flowers white off-white, sepals and petals spreading, 1.5-2.5 cm across; sepals subequal, 5-veined, oblong lanceolate; dorsal sepal ca. 2.1 × 0.6-0.7 cm; lateral sepals ca. 2.2 × 0.8 cm; petals broader, obovate oblong, ca. 2.3 × 1.2 cm, apex acute obtuse, 7-veined; lip ca. 2.1 × 1.5-1.7 cm, broadly obovate, emarginated, sessile on the base of column, entire, ventricose at the base; sides of the hypochile erect; epichile undulate, edge deflexed, two irregular rows of thick warts starting from the base of the epichile and ending before the apex, hypochile golden brown within, epichile yellow at base and pink at apex; column stout, short, oblong, slightly dilated, ca. 0.5-0.6 × 0.3 cm long; stigma squarish, ca. 0.2 cm long, anther broadly ovate orbicular in outline, ca. 0.3-0.4 cm, off-white with brown tinge, the locules pouch like; pollinia yellow, obliquely oblong ovoid, porate behind, ca. 0.2 × 0.15 cm, stipe hyaline, subquadrate (Fig. 1).

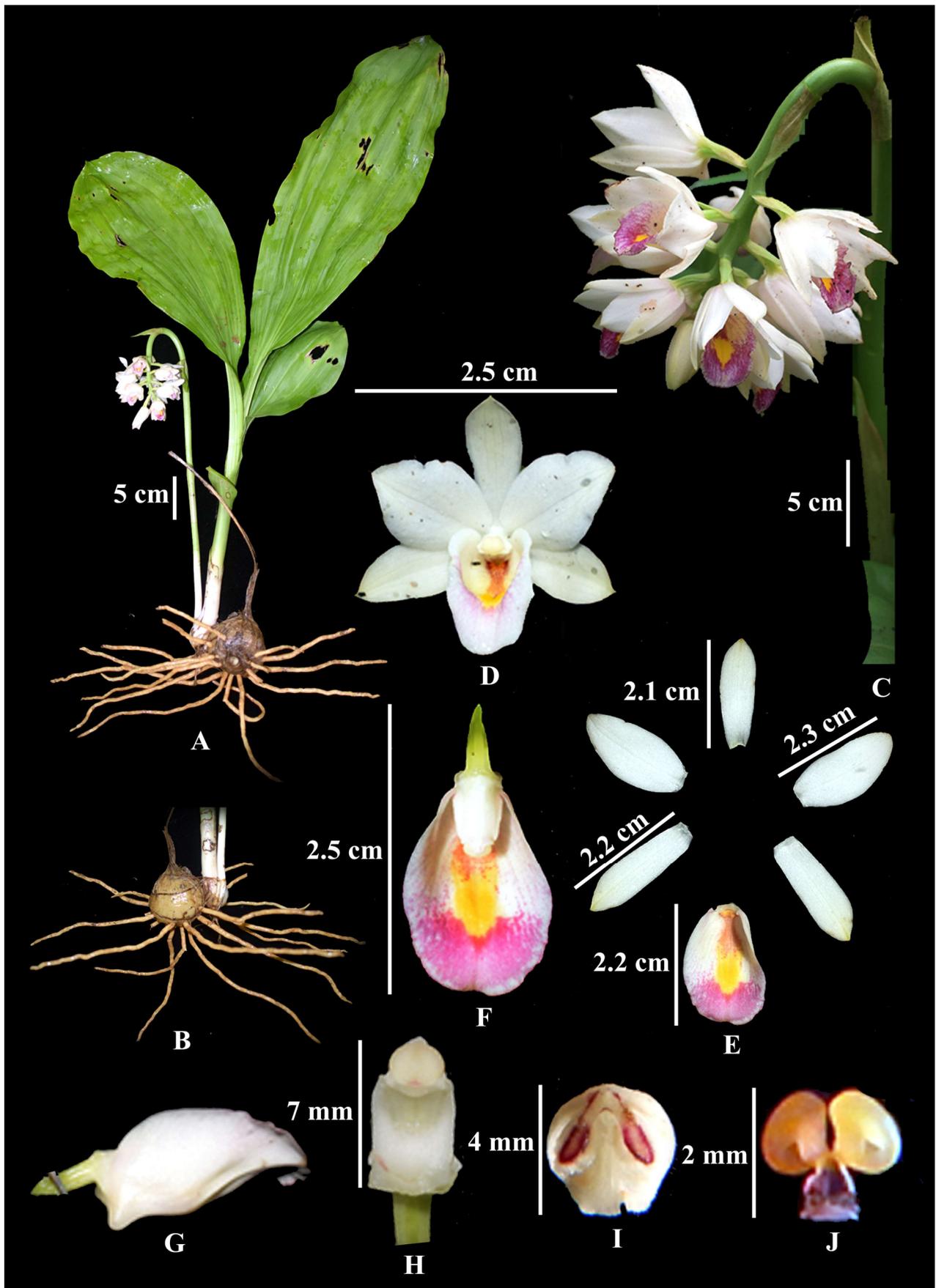


Fig. 1 : *Geodorum laxiflorum*

A: habit – B: tuber – C: inflorescence – D: flower – E: flower segments – F: lip with column and ovary – G: lip (side view) – H: ovary and column – I: anther cap – J: pollinia (ph. M.R.Bhatt)

Flowering: June-July; fruiting: August-October.

Etymology: this species name is derived from the Latin words, *laxo* meaning 'loose' and *flos* meaning 'flower'. General distribution: India (Assam, Chhattisgarh, Odisha, Jharkhand, Gujarat); endemic.

Habitat & ecology: the habitat is dominated by tropical moist deciduous forests with an average rainfall of 2000 mm. The species was found growing in black clay soil in the shade of bamboo in association with *Sida rhombifolia* Linnaeus, *Curculigo orchioides* J.Gaertner, *Curcuma decipiens* Dalzell, *Adiantum* sp. It was observed that the inflorescence in this orchid emerges as soon as the pre-monsoon rainfall starts.

Taxonomic note: this species was first reported by D.T.Jenkins from Assam and planted in the Indian Botanic garden, in Calcutta. G.W.Griffith described it in 1845. According to Griffith this species is allied to *Geodorum dilatatum* R.Brown (= *Geodorum recurvum*), but differs from it by its spike of thin flowers, the broad petals and the broadly ovate squarish lip. Hooker (1890) listed this species among the doubtful species, clearly noting the close resemblance with *Geodorum citrinum* G.Jackson. However *G. citrinum* has yellow flowers, an oblong pollinarium gland which is truncate at the apex, without any teeth on its lateral edges. According to Seidenfaden (1983) the Griffith's species is not *G. citrinum*. However this species was reported by Misra (2004) from Ganjam district of Odisha and Kumar (2008) from Jharkhand state.

Specimen examined: India, Gujarat, Dangs, Waghai (20°45.085'N - 73°29.680'E), 156 m, 8.10.2014 (flowered in 17.7.2015), M.R. Bhatt 142 (BSI Jodhpur).

Conservation status: as already said, *Geodorum laxiflorum* is endemic to India. As indicated on Fig. 2, there are eight localities known for this species based on the present field survey, herbarium records and literature over the period 1845-2015. These localities were imported into GeoCAT (Bachman *et al.*, 2011; <http://geocat.kew.org/>) and the extent of occurrence (EOO) was calculated to be 559,086.343 km² (far exceeding the 20,000 km² upper limit for "Vulnerable" status under the criterion B1 (under IUCN criteria 'B' of geographical range), while area of occupancy (AOO) was calculated to be 32 km² (which falls within the limits for "Endangered" status under the criterion B2). The number of localities exceeds the upper limit for endangered status. Habitat fragmentation due to clearing forest

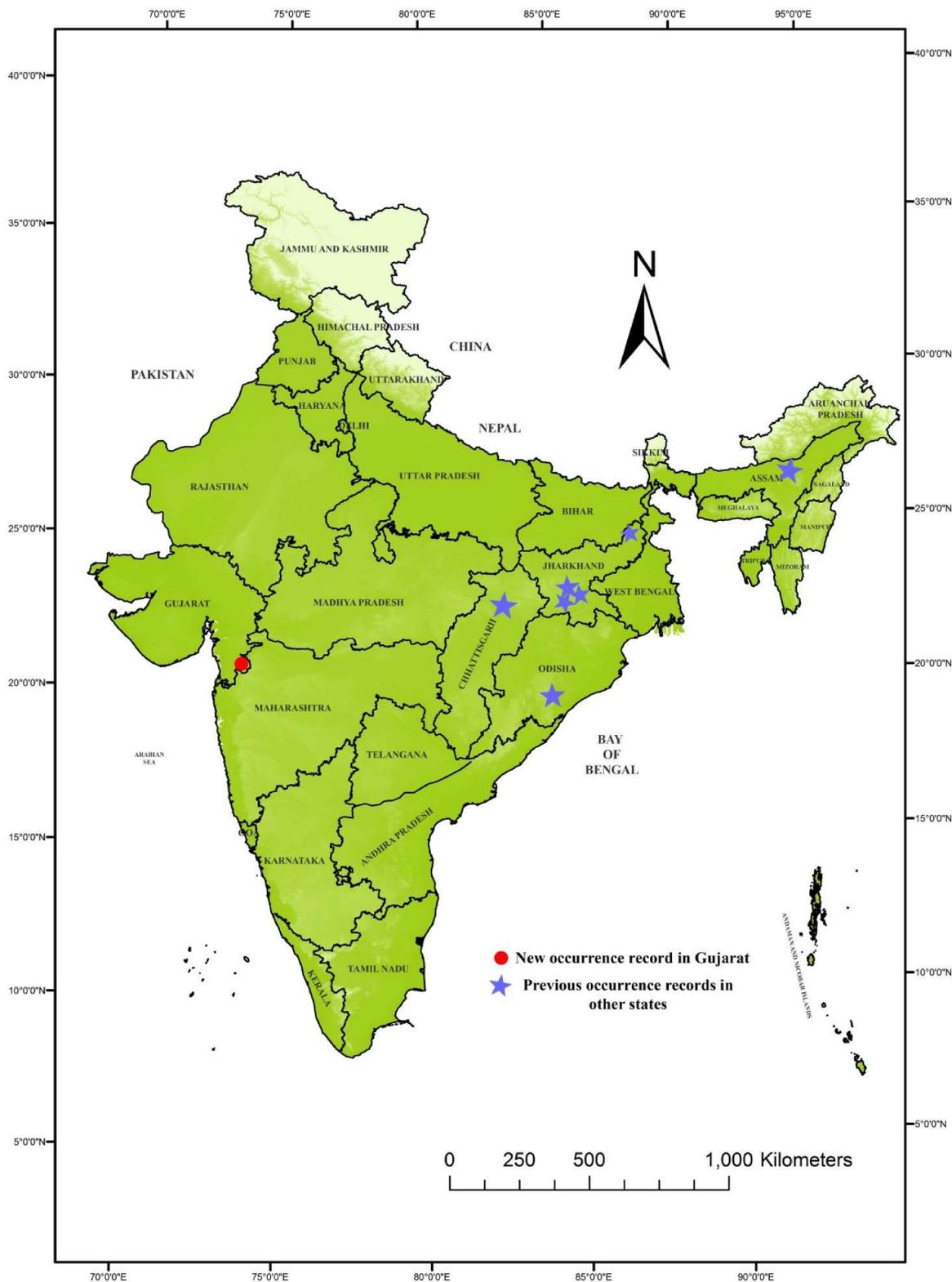


Fig. 2 : Distribution of *Geodorum laxiflorum* in India

for agricultural use and shifting cultivation in north east region of India are the main threats. In Jharkhand and Odisha, *G. laxiflorum* is also reported to be rare (Kumar, 2008; Misra, 2004) due to human induced activities,

industries, mining, settlement, development projects and removal of forest products, over grazing and forest fires. In Chotanagpur region of Jharkhand state it is also collected by the local practitioners as it is being used in curing in malignant tumours, stomach ache and joint pain (Besra *et al.*, 2011). It has not been reported from Assam after its first record. In the present survey only 25-30 individuals were located in Dangs district of Gujarat state. The particular site is prone to soil erosion due to agricultural invasion. Based on the present observations we conclude that it should be evaluated as “Vulnerable” under the B2ab(i,ii,iii,iv) criteria of the IUCN red list guidelines (2001: version 3.1). The *ex situ* conservation efforts for this species were made by the Forest Department Ahwa, Dangs and Maharaja Sayajirao University of Baroda, Vadodara.

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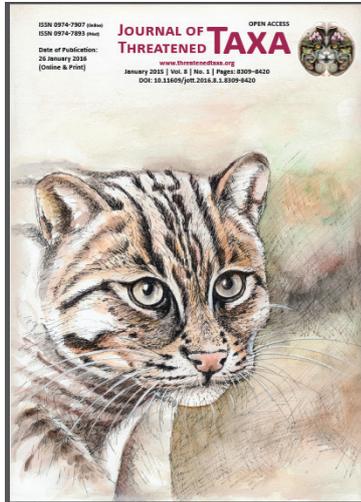
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NOTE

**OBERONIA MUCRONATA (D. DON) ORMEROD & SEIDENF.
(ORCHIDACEAE), NEW ADDITION TO THE FLORA OF GUJARAT, INDIA**

Mital R. Bhatt & Padamnabhi S. Nagar

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The genus *Oberonia*, belonging to the family Orchidaceae, subfamily Epidendroideae, tribe Malaxideae and subtribe Malaxidinae was described by John Lindley in 1830. It comprises between 329 species distributed from South Africa through Asia to Australia and the Pacific islands with a single species in Madagascar and tropical Africa (Pearce & Cribb 2002; Govaerts et al. 2015).

The genus is epiphytic, rarely lithophytic, easily recognized by its clustered, fleshy, laterally compressed, ensiform, distichous leaves; terminal racemose inflorescence and small, numerous, non-resupinated flowers. In India, *Oberonia* is represented by 68 species (Ansari & Balakrishnan 1990; Misra 2007; Narayanan et al. 2010) and in Gujarat by two species (Anonymous 1996).

During the field survey for orchids of Gujarat, the first author collected a few plants of the genus *Oberonia* when it was flowering during the month of October 2014 from Dang District of southern Gujarat. On critical observation and perusal of the relevant literature (Santapau & Kapadia 1964; Abraham & Vatsala 1981) the specimens were identified as *Oberonia mucronata* (D. Don) Ormerod & Seidenf. After a scrutiny of the significant literature (Suryanarayana 1968; Desai 1976; Shah 1978, 1983; Vora 1980; Reddy 1987; Bole & Pathak 1988; Anonymous 1996, 1998–2002, 2001; Tadvī 2014), it was found to be a taxon hitherto not recorded from Gujarat State, hence it is reported here as a new

OBERONIA MUCRONATA (D. DON) ORMEROD & SEIDENF. (ORCHIDACEAE), NEW ADDITION TO THE FLORA OF GUJARAT, INDIA

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distribution record for the state. The present location in Gujarat is also the western most geographic range for this species. The voucher specimen is deposited in the herbaria of The Maharaja Sayajirao University of Baroda (BARO), and the Botanical Survey of India, Jodhpur (BSJO). With the current report, the genus *Oberonia* is now represented by three species, viz., *O. falconeri* Hook.f., *O. brunoniana* Wight and *O. mucronata* (D. Don) Ormerod & Seidenf. in Gujarat.

Globally the species has a wide range of distribution. In India it is distributed in Andhra Pradesh, Assam, Karnataka, Kerala, Maharashtra, Mizoram, Orissa, Tamil Nadu and Uttarakhand. In Gujarat very few individuals of this species were seen at Ahwa, Dangs District (Fig. 1). A detailed taxonomic description and images are provided here along with its habitat, regional distribution and geographical distribution to authenticate the new distribution record. An easy identification key to *Oberonia* species of Gujarat is provided.

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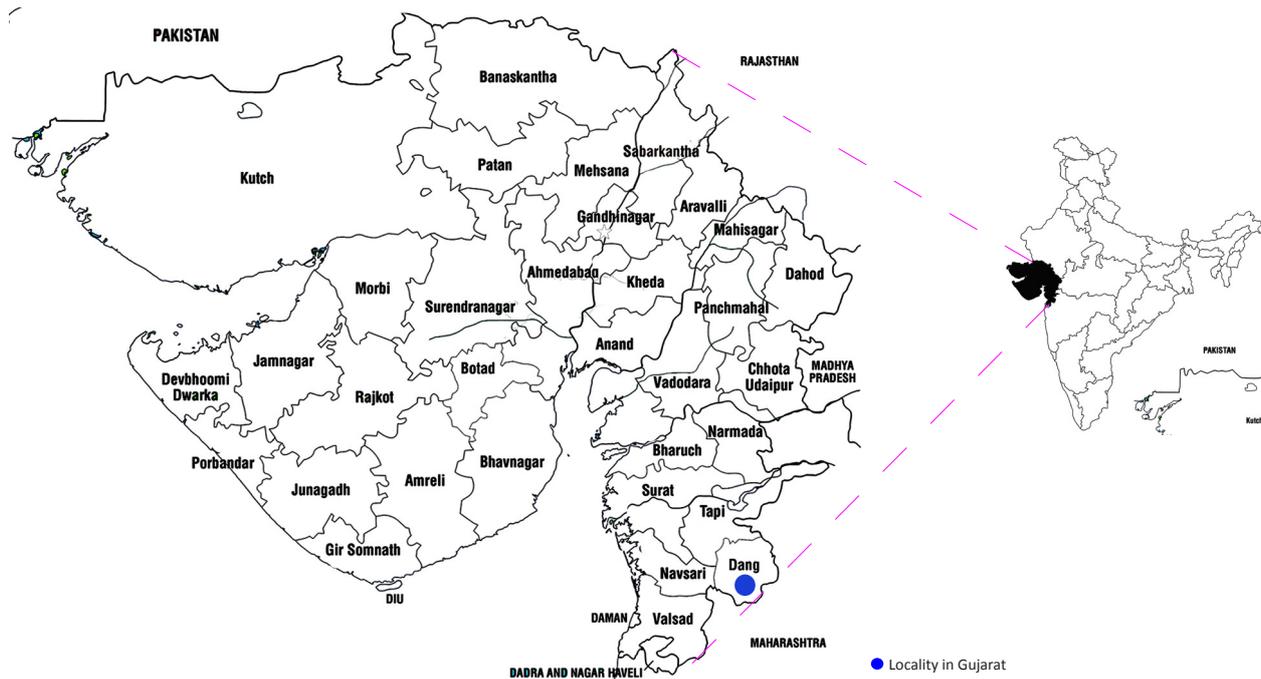


Figure 1. Distribution of *Oberonia mucronata* (D. Don) Ormerod & Seidenf in Gujarat.

Oberonia mucronata (Image 1)

(D. Don) Ormerod & Seidenf. in G. Seidenfaden, Contr. Orchid Fl. Thailand. 13:20 (1997). *Stelis mucronata* D. Don in Prodr. Fl. Nepal. 32. 1825; *Cymbidium iridifolium* Roxb. in Fl. Ind. ed. 1832, 3: 458 (1832); *Oberonia denticulata* Wight in Icon. P1. Ind. Orient. 5: t. 1625 (1851); *Malaxis denticulata* (Wight) Rchb.f. in Ann. Bot. Syst. 6: 208 (1861); *O. iridifolia* var. *brevifolia* Hook. f. in Fl. Brit. India 5: 676 (1890); *O. iridifolia* var. *denticulata* (Wight) Hook. f. in Fl. Brit. India 5: 676 (1890). *O. denticulata* var. *iridifolia* (Roxb.) S. Misra in J. Orchid Soc. India 3: 69 (1989); *O. denticulata* var. *brevifolia* (Hook.f.) S. Misra in J. Orchid Soc. India 3: 70 (1989); *O. brevifolia* (Hook.f.) Panigrahi in S.K. Murti & G. Panigrahi, Fl. Bilaspur Distr. 2: 591 (1999); *O. smisrae* Panigrahi in S.K. Murti & G. Panigrahi, Fl. Bilaspur Distr. 2: 593 (1999).

Isotype: 1832, Silet, Bangladesh, N. Wallich, # 1948b (P00404924) (P!).

Erect or pendulous epiphytic herb, 19–22 cm long with inflorescence. Leaves 4 to 5, clustered, 7–9.5×1.5–1.7 cm, distichous, laterally compressed, thick, fleshy, pale green, oblong-ensiform with acute apex. Scape 3–4×0.3 cm, flattened, adnate to the upper leaf in young plants, Inflorescence 16–19 cm long, decurved, densely flowered. Flowers pedicelled, 2–2.5 mm long, golden yellow, bracteate. Bracts equaling the size of ovary, 1.3×0.7 mm, ovate to oblong, acute or obtuse, irregularly denticulate along the margin. Dorsal sepal



Image 1. *Oberonia mucronata* (D. Don) Ormerod & Seidenf. a - habit; b - part of inflorescence with flowers; c - side view of flower; d - front view of flower; e - petal; f - lip

Key to identification of *Oberonia* of the Gujarat

1. Lip with entire margin;
2. Leaves up to 8cm, pale green, scape cylindrical *O. falconeri*
2. Leaves up to 28cm, purplish-brown, scape flat *O. brunoniana*
1. Lip with deeply toothed or lacinate margin *O. mucronata*

1–1.2×0.8 mm, ovate, acute, entire along the margins; lateral sepals narrower with acute apex. Petals 1×0.5, ovate to oblong, obtuse with irregularly erose margin. Lip quadrate in outline, glabrous or sparsely hairy, gland-dotted, 5×5 mm, 3-lobed, lateral lobes oblong, deeply dentate, spreading in flower except for the incurved distal end; middle lobe two-lobuled, lobules triangular, acute, deeply dentate. Ovary with pedicel 1.2–1.5 mm long, glabrous. Column 1 mm long, subglobose, sessile. Capsule 0.3× 0.1 mm, ellipsoid with a short pedicel (Image 1).

Specimen Examined: 0094 (BSJO!), 28.x.2014, 20°43'39.72"N & 73°40'22.86"E, 297m, Ahwa, Dangas, Gujarat, India, coll. Mital R. Bhatt.

Flowering & Fruiting: August–December

Habitat and Ecology: *Oberonia mucronata* was mostly observed on the tree trunk of *Terminalia crenulata* in moist deciduous forest, in association with other members of Orchidaceae like *Oberonia falconeri*, *Vanda tessellata* and *Vanda testacea*.

Global distribution: India (Andhra Pradesh, Assam, Gujarat, Karnataka, Kerala, Maharashtra, Mizoram, Tamil Nadu and Uttarakhand), Bangladesh, Bhutan, China, Indonesia, Jawa, Laos, Malaya, Malaysia, Myanmar, Nepal, Philippines, Thailand and Vietnam.

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Cleome hirta (Cleomaceae), an addition to Asia from Gujarat, India

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Abstract

Cleome hirta (Klotzsch) Oliv. (Cleomaceae), a species indigenous to tropical Africa is reported here as an addition to the angiospermic flora of Asia from Gujarat state, Western India. Detailed description, colour photographs, flowering and fruiting period, details on habitat, plant association and distribution of the species are provided here.

Keywords: Cleomaceae, *Cleome*, Gujarat, New Record

Introduction

Cleome L. (Cleomaceae), a pantropical genus comprises 250–280 species (Sanchez-Acebo, 2005; Inda *et al.*, 2008; Mabberley, 2008). In India, it is represented by 15 species and 2 varieties (Sundararaghavan, 1993), of which 9 species are distributed in Gujarat state (Santapau, 1962; Shah, 1978). During the floristic explorations in Gujarat state, a small population of a *Cleome* species was observed in Dabhoi taluka, Vadodara district, and a few specimens were collected from the existing population by first author for study. The collected voucher specimens are studied critically with literature and identified as *C. hirta* (Klotzsch) Oliv., a species indigenous to tropical Africa. The identification was further confirmed by matching the specimens with electronic images of herbarium specimens at Kew Herbarium Catalogue (<http://www.apps.kew.org>). Hence, it is reported here as an addition to the flora of Asia with detailed description and colour photographs for its easy identification. The present report makes 10 species from the state of Gujarat and 16 species and 2 varieties of *Cleome* in India.

Cleome hirta (Klotzsch) Oliv. in Oliv. *et al.*, Fl. Trop. Afr. 1: 81. 1868. *Decastemon hirtus* Klotzsch in Peters, Naturw. Reise Mossambique 6 (Bot., 1): 157. 1861. **Fig. 1**

Undershrub, perennial, erect, 1.5–2 m high, branched. Stems terete, striated, 8.5–9 cm in diam., densely covered with glandular hairs. Leaves

alternate, exstipulate, 5–9-foliolate; petioles 0.8–5.3 cm long, viscid, glandular, pubescent; leaflets linear to lanceolate, 1–3.7 × 0.3–0.6 cm, decreasing in size upwards and passing gradually into sessile bracts, cuneate at base, entire at margins with glandular hairs, subacute to rounded at apex; petiolules *c.* 1 mm long. Inflorescence a raceme, terminal with 50–60 flowers, initially dense but during fruiting it elongates greatly. Flowers 2.6–3.1 cm long, subtended by small, sessile 5-foliolate bracts; pedicels 1.5–1.8 cm long, covered with glandular hairs. Sepals 4, linear, 0.8–1 × *c.* 0.1 cm, acute at apex, glandular, pubescent. Petals 4, oblong to oblanceolate, 1.8–2 × 0.4–0.6 cm, distinctly clawed, obtuse at apex, all with shade of purple throughout, except the 2 middle ones with a yellow blotch at the middle with blue boundary. Stamens 11, unequal, exerted; filaments free, glandular-hairy at base; the outer longer stamens 6, 2–2.5 cm long; anthers grey; the inner shorter stamens 5, 1.5–1.9 cm long; anthers yellow. Ovary linear, 0.9–1.1 cm long, glandular, pubescent; gynophore *c.* 1 cm long, glandular-hairy; style 0.2–0.3 cm long, glabrous; stigma subcapitate. Capsules narrowly linear, 9–16 × *c.* 0.2 cm, straight or slightly curved on maturity, spreading; gynophores 1.5–2 cm long; seeds 42–67, reniform, *c.* 0.2 mm in diam. with conspicuously rugose-tuberculate transverse ridges, glabrous, black.

Flowering: December–March; *Fruiting:* April–May.

Habitat: Wastelands and on roadsides in association with *Achyranthes aspera* L., *Breynia retusa* (Dennst.)

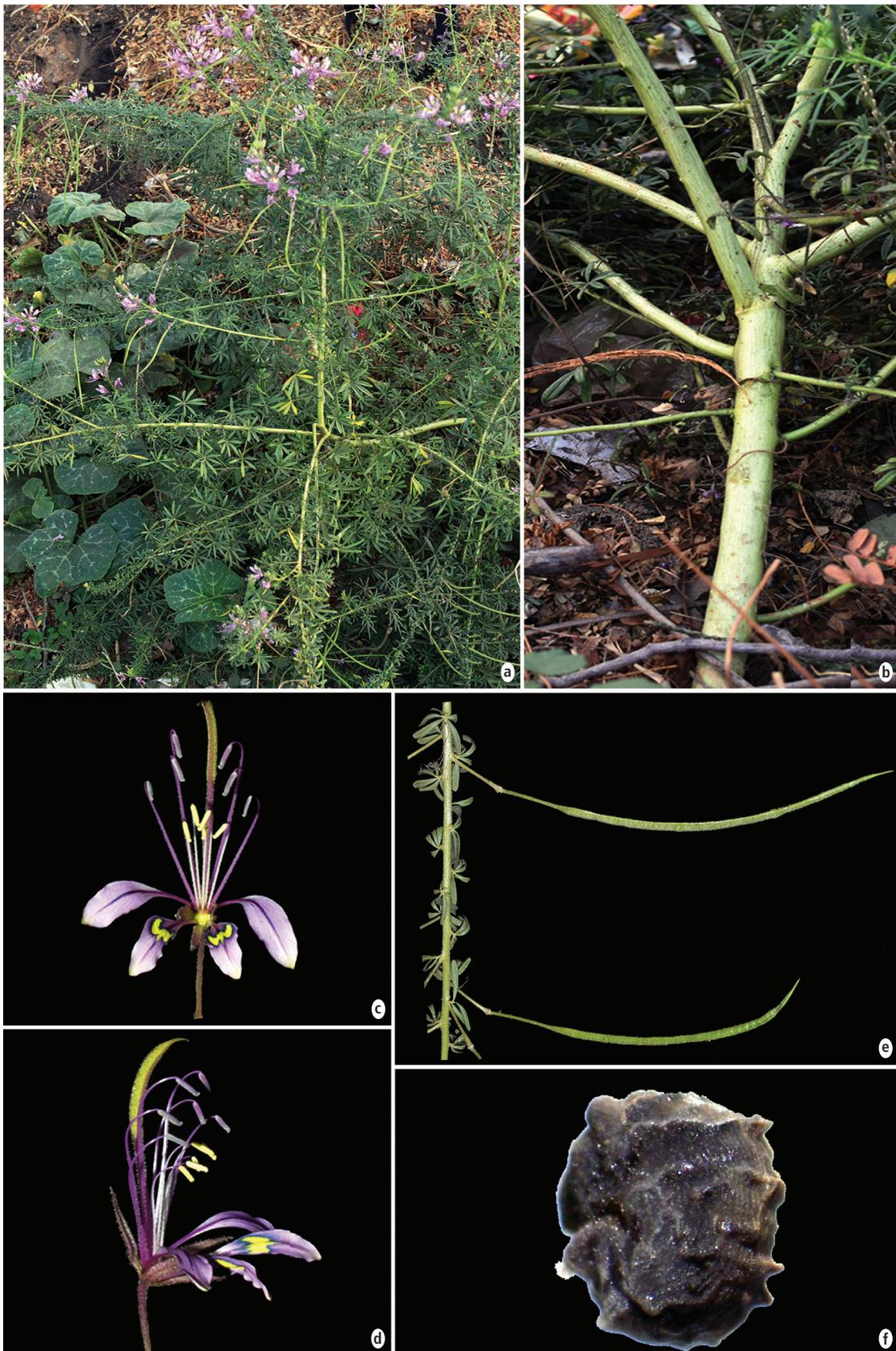
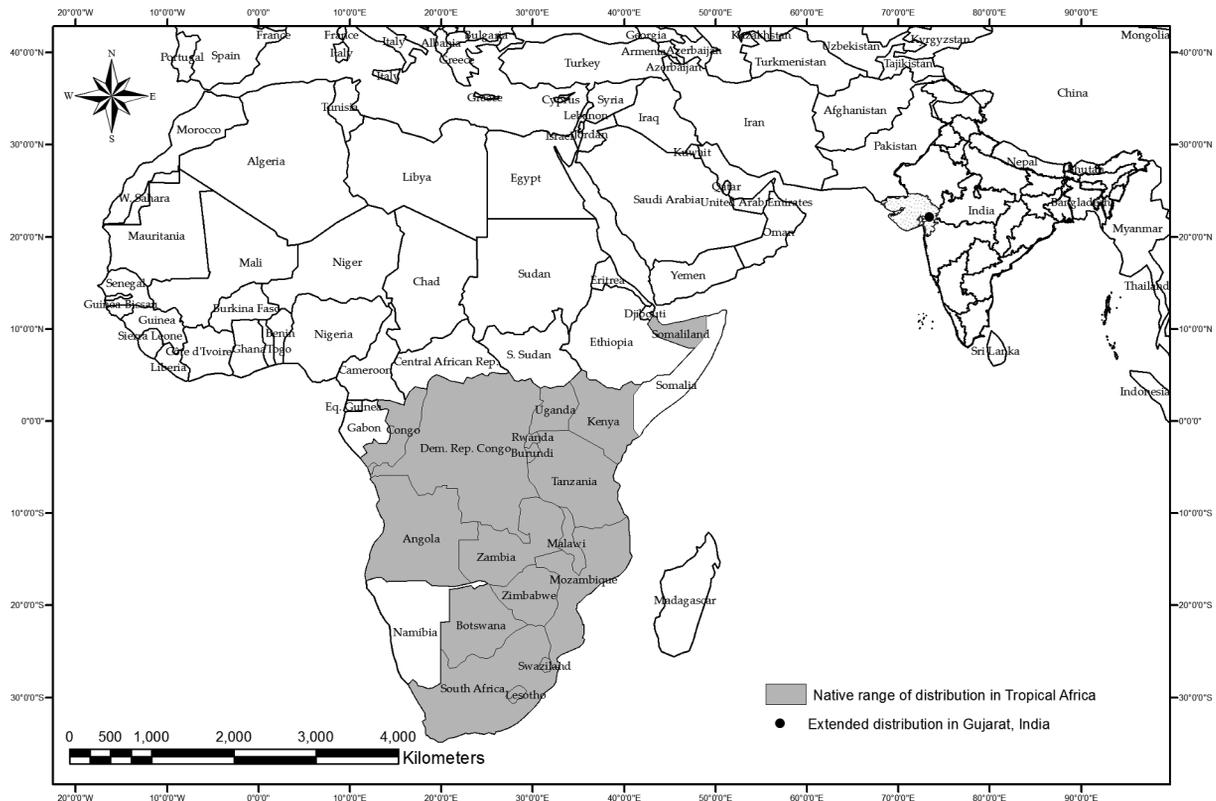


Fig. 1. *Cleome hirta* (Klotzsch) Oliv.: a. Habit; b. Basal portion of stem; c,d. Front and side views of flower; e. A portion of fruiting-twig; f. Seed.



Map. Global distribution of *Cleome hirta* (Klotzsch) Oliv.

Alston, *Cardiospermum halicacabum* L., *Fagonia cretica* L., *Ipomoea carnea* Jacq. subsp. *fistulosa* (Mart. ex Choisy) D.F. Austin.

Specimen examined: INDIA, Gujarat, Vadodara district, Faratikui, 22°8'58.48" N, 73°22'49.72" E, 91 m, 29.1.2015, Mital R. Bhatt MB120 (BARO).

Distribution: Indigenous to tropical Africa (Angola, Botswana, Congo, Democratic Republic of the Congo, Kenya, Limpopo Malawi, Mozambique, Mpumalanga, Somalia, Somaliland, South Africa, Tanzania, Uganda, Zambia and Zimbabwe), now in India (Faratikui, Vadodara district, Gujarat). **Map**

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RESEARCH NOTES

(I)

PERISTYLUS CONSTRICTUS (ORCHIDACEAE) - A NEW ADDITION FOR GUJARAT, INDIA

Introduction

During an orchid exploration of Gujarat state in 2014, a small population of *Peristylus* Bl. was observed in Chhotaudepur district of Central Gujarat and Sabarkantha district of North Gujarat. On detailed examination and with the help of standard floras (Hooker, 1894; Deva and Naithani, 1986; Misra, 2004), the species was identified as *Peristylus constrictus* (Lindl.) Lindl. On perusal of relevant literature (Suryanarayana, 1968; Desai, 1976; Shah, 1978; Vora, 1980; Reddy, 1987; Bole and Pathak, 1988; Anony., 1996; Tadvi, 2014) revealed that earlier this species had not been reported from Gujarat. The present collection, thus, represents its first record for Gujarat. A detailed description along with its photographs (Fig. 1) is provided for easy identification. The voucher specimens have been deposited in herbaria of The Maharaja Sayajirao University of Baroda (BARO), and Botanical Survey of India, Jodhpur (BSJO). With this present report, the genus *Peristylus* is now represented by 5 species in Gujarat. An easy identification key to *Peristylus* species of Gujarat is provided below:

Key to identification of *Peristylus* of the Gujarat

1. Spur as long as or longer than the sepals, linear, subclavate..... *P.stocksii*
 Spur much shorter than the sepals, saccate or globose.....2
2. Lip obscurely tri-lobed, shorter than the broad sepal, petals, creamish-white, broad, obliquely orbicular..... *P. plantagineus*
 Lip distinctly tri-fid.....3
3. Plants below 20 cm high, spike lax; dorsal sepal and petals broadly ovate, midlobe of lip triangular, obtuse..... *P.lawii*
 Plants 30-80 cm in height.....4
4. Lip shorter than the broad sepal, obscurely tri-lobed, petals, creamish-white, broad, obliquely orbicular..... *P.plantagineus*
 Spike dense flowered, lip equal to or longer than the sepal.....5
5. Lip tri-fid to the middle, the segments all slender, linear-lanceolate; spike dense flowered, nearly cylindrical..... *P.constrictus*
 Lip shortly tri lobed, midlobe of lip much shorter than the sidelobes..... *P.godyeroides*

Systematic treatment

Peristylus constrictus(Lindl.) Lindl. in Gen and Sp. Orch. 300. 1835; Seidenf. in Dansk Bot. Ark. 31(3): 46. F. 20. 1977; Deva and Naithani in Orch. Fl. N. W. Himalayas. 181. Fig. 93. 1986; Misra in Orch. Orissa 153. 2004. *Herminium constrictum* Lindl.in Edward's, Bot. Reg. 18: sub. t. 1499. 1832. *Habenaria constricta* (Lindl.) Hook.f.in Fl. Brit. India 6: 161. 1890.

Type: Nepal, Gualore. *N. Wallich* 7043.

Terrestrial herbs, 40–60 cm tall; tuber, ovoid or broadly ellipsoid, 4–5cm long. *Stem* erect, stout, 1–1.2 cm thick, sheathed at the base. *Leaves* 4–6, ovate–elliptic, clustered at the middle of the stem, 7–13.5 × 5–8.5cm, acute–acuminate, green above and pale green below. *Inflorescence* spike, cylindrical, up to 25 cm long, densely flowered. Flowers white, sweet scented, spreading. *Bract* lanceolate, acuminate, longer than the

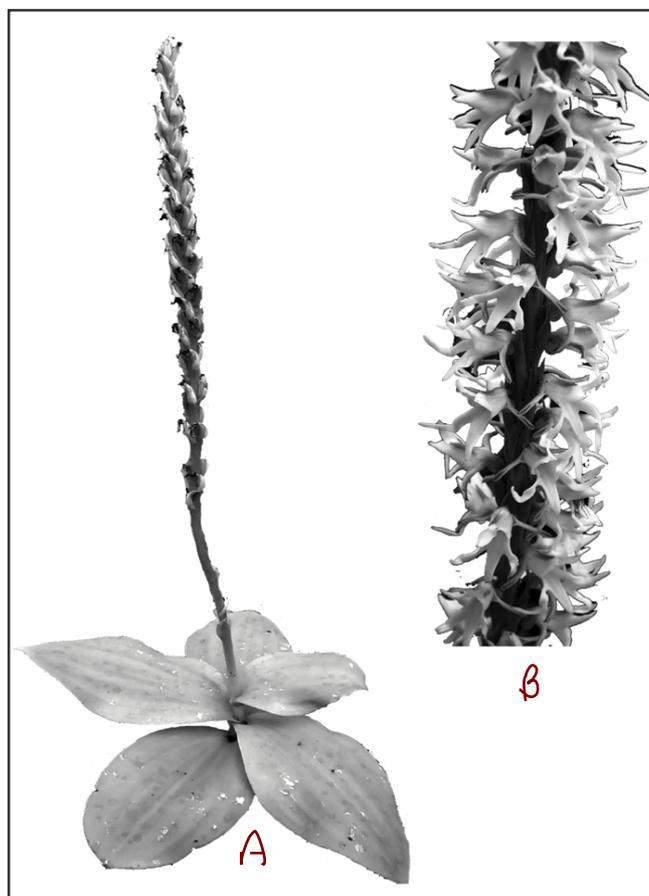


Fig. 1: A. Habit with fruits: B. Part of inflorescence

ovary. *Sepals* sub equal, single veined; dorsal hooded, concave; laterals spreading, margins involute. *Petals* larger than the sepals, white, spreading, ovate-lanceolate, pointing upwards but not forming hood with dorsal sepal. *Lip* white, porrect, sessile, 14–16 mm, deeply 3-lobed; side lobes acute; midlobe shorter and broader, subacute. *Spur* short, scrotiform, suppressed, green. *Column* short and globular. *Capsule* 1.2–1.4 cm long (Fig. 1).

Flowering : July–August, **Fruiting** : August–September

Distribution: India (Gujarat (present collection), Aruanchal Pradesh, Assam, Bihar, Himachal Pradesh, Meghalaya, Madhya Pradesh, Maharashtra, Odisha, Sikkim, Uttarakhand, West Bengal). Nepal, Bangladesh,

China (Yunnan), Cambodia, Laos, Myanmar, Thailand and Vietnam.

Habitat: The habitat is dominated by tropical deciduous forests. It was found to be growing in black clay soil in association with *Curcuma decipiens* Dalzell, *Dioscorea bulbifera* L., *Oplismenus burmanni* (Retz.) P.Beauv., *Curculigo orchroides* Gaertn., *Peristylus lawii* Wight, *Senna uniflora* (Mill.) H.S. Irwin and Barneby, *Adiantum* sp., *Lindernia* sp. It was observed that the plants emerge with the first showers of pre-monsoon rains.

Specimen examined: India, Gujarat, Panchmahal, Chhotaudepur, 170 m above msl, 27th July 2014, *Mital R. Bhatt.*, MB75 (BSJO).

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