Taiwania 61(1): 16–20, 2016
DOI: 10.6165/tai.2016.61.16

Revisiting the *Delphinium viscosum* Hook. f. & Thoms. (Ranunculaceae) complex in the Himalaya

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(Manuscript received 1 October 2015; accepted 4 December 2015)

ABSTRACT: The paper highlights the complex nature of *Delphinium viscosum* Hook. f. & Thoms. in the Himalaya and enumerates two subspecies and two varieties. Critical appraisal of the morphological and distributional data revealed that subsp. *viscosum* and subsp. *gigantobracteum* having two varieties var. *gigantobracteum* and *chrysotrichum* are distinct. *Delphinium viscosum* complex is solved out and two subspecies and two varieties with clear cut distinct macro and micro-morphological characters have been identified. The taxonomic status of different taxa of this complex species has been established. *Delphinium viscosum*, a taxonomic complex species is described and illustrated.

KEY WORDS: *Delphinium viscosum*, Himalaya, India, Species complex, Ranunculaceae.

INTRODUCTION

Huth (1895) while revising the genus *Delphinium*, divided *Delphinium viscosum* Hook. f. & Thoms. into two varieties i.e. var. *gigantobracteum* and var. *chrysotrichum*. Bruhl and King (1896) identified *D. viscosum* as a polymorphic taxa having intermediate forms and described 4 varieties, viz. *chrysotricha*, *ciliata*, *connectens* and *gigantobractea*. Chatterjee (1948) described a new species *Delphinium conocentrum* based on several syntypes from east Himalaya. He differentiated his new species from *D. viscosum* in having a fewer flowered inflorescence, globose flowers, lobed bracts, much broader spur and throughout hairy ovary. Mukerjee (1960) published a new species *D. aureopilosum* and also recognized 2 varieties i.e. vars. *chrysotrichum* and *gigantobracteum* and he placed vars. *ciliata* and *connectens* of Bruhl as synonyms of *D. viscosum*. Munz (1967) while revising the Asian species of *Delphinium* treated all the varieties of Bruhl as synonyms of *D. viscosum* and also placed *D. trilobatum* Huth, *D. conocentrum* Chatterjee and *D. aureopilosum* Chowdhury ex Mukerjee under *D. viscosum* as synonyms.

Moreover, new species *D. aureopilosum* Chowdhury ex Mukerjee had been noticed by Chowdhury but without any description. While consulting CAL, we came across a few vouchers of *D. viscosum* which were annotated by Chowdhury as *D. aureopilosum*, but Chowdhury never formally published *D. aureopilosum* as a new species. As stated earlier *D. viscosum* is highly polymorphic taxa and elicits a vast quantum of morpho-variations and if intermediate forms are not existing, it would be possible to split the species into well tolerable two to three species, which indicates the species is one of most complex and confusing taxa of the genus *Delphinium*.

While on a botanical trip to Sikkim Himalayas in September, 2014, we came across one small population of *D. viscosum* with dull greenish yellow flowers in Thegu, 5 km after Chhangu towards Serathang in East Sikkim at an altitude of 3898 m (27°22.539′ N, 88°47.158′ E), this could easily be recognized on the basis of peculiar flower colour different from other existing *Delphinium* taxa which are mainly blue in colour. After returning back, we critically studied the specimens under microscope and also consulted the available literature on the subject. While examining the vouchers from different herbaria (BM, E, K, DD, CAL, BSD, LWG), we found several overlapping characters creating taxonomic confusion in this group, therefore, after critical study we resolved the taxonomic confusion prevailing in this complex. The variations existing in this polymorphic species are pronounced in vegetative structure as well as in floral structures, particularly in reproductive organs. The variations are not of random occurrence but are associated with leaf, bract and bracteole structure in a manner portraying an evolutionary lineage within the complex; the deeply multi-lobed leaves are associated with very short bract and distantly placed bracteoles and glabrous ovary whereas tri-lobed leaves are associated with large bracts, bracteoles at the base of flowers and hairy ovary. The intermediate forms are also well represented within the one and same species.

MATERIALS AND METHODS

During a botanical trip for collection of taxa of Tribe Delphineae to Sikkim region of the eastern Himalaya, we found a small population of greenish yellow flowered *Delphinium* species in the eastern part of Sikkim. The plant was recognized as belonging to the species of *Delphinium viscosum* and analyzed through the comprehensive work of earlier

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premier workers (Huth, 1895; Bruhl & King, 1896; Munz, 1967). The taxon was also compared with type specimens, protologues and descriptions of morphologically similar taxa. Macro and micro-morphological studies of fresh and dry material was performed with the aid of stereozoom trinocular microscope and indented key was prepared to differentiate the infra-specific taxa under *D. viscosum*. The area of occupancy, altitude, latitude and longitude was noted down.

TAXONOMIC TREATMENT

The infra-specific taxa of this himalayan species are described as follows:

Delphinium viscosum Hook. f. & Thoms., Fl. Ind. 1: 52. 1855; Fl. Brit. India 1: 27. 1872; Kihara, Fauna Fl. Nepal Himal. 1: 130. 1952-1953; Mukerjee, Bull. Bot. Surv. India 2(34): 295. 1960; Munz, J. Arn. Arb. 48(3): 495. f. 7. H & I. 1967; Hara, Enum. Flow. Pl. Nepal 2: 18. 1979; Grierson, Long, Fl. Bhutan 1(2): 311. 1984; Polunin & Stainton, Flow. Himal. 6. t. 2. 1984; Rau, Sharma *et. al.*, Fl. India 1: 101. 1993; Hajra, Fl. W. Bengal (Fl. India Series 2) 1: 126. 1997; Yuan & Yang, Acta Phytotax. Sin. 42: 188. 2004; Yoshida, Himal. Pl. Ill. 600, f. 1. 2005; Ohba *et. al.*, Fl. Mustang 64. 2008. Type: **INDIA**: Sikkim: 15-16,000 ft., *J. D. Hooker s. n.* (BM- Photo!). **Spiked Larkspur**

Delphinium viscosum Hook. f. & Thoms. var. *ciliata* Bruhl in Bruhl & King, Ann. Bot. Gard. Calc. 5: 104. 1896. Type: **INDIA**: Sikkim, 15–16,000 ft. (Hook. f. & Thoms.), Western Sikkim, *King's collector s. n.* (CAL).

Delphinium viscosum Hook.f. & T. var. *connectans* Bruhl in Bruhl & King, Ann. Bot. Gard. Calc. 5: 104. 1896. Type: **INDIA**: Sikkim: Sebu Valley, *Gammie s. n.* (CAL).

Delphinium trilobatum Huth, Bull. Herb. Boiss. 1:330. 1893. Type: **INDIA**: Sikkim: 4000–5000 m, *Anderson 1863* (BE-*n.v.*).

Herbaceous; stems upto 60 cm tall, hollow, covered with short yellow glandular hairs, paniculately branched from base, scattered leafy. Leaves both radical and cauline, petiolate; petiole 7–20 cm long, dilated at base, lamina sub-orbicular reniform, 4.5–5.0 × 8.5–9.0 cm, pubescent on both surface or only on dorsal surface, deeply multilobed to trilobed, the lobes coarsely crenate-dentate into broad round-ovate teeth that are glandular apiculate at the tips. Flowers purple, pale blue, dull violet, or greenish-yellow, solitary or upper entire, linear lanceolate, 0.7–2.3 cm long, hairy; bracteoles 2, opposite, 0.8–2.0 cm long, linear-oblong, placed at the base of flower or 0.6-0.8 cm away from the flower. Sepal 17–21 × 10–16 mm, outer surface hairy, inner surface glabrous or hairy, conspicuously veined; spur 15–17 mm long, incurved, hairy. Staminode 13–16 mm long, lamina clefted for ca. 3 mm, densely hairy, claw 7–9 mm long, hairy. Stamens 6–9 mm long, glabrous, lower part of filament membranous; anthers dark, 1.0–1.2 mm long. Carpels 3, 5–11 mm long, glabrous or hairy, sutures ciliate when glabrous. Fruits 3, 9–12 mm long, glabrous except at sutures.

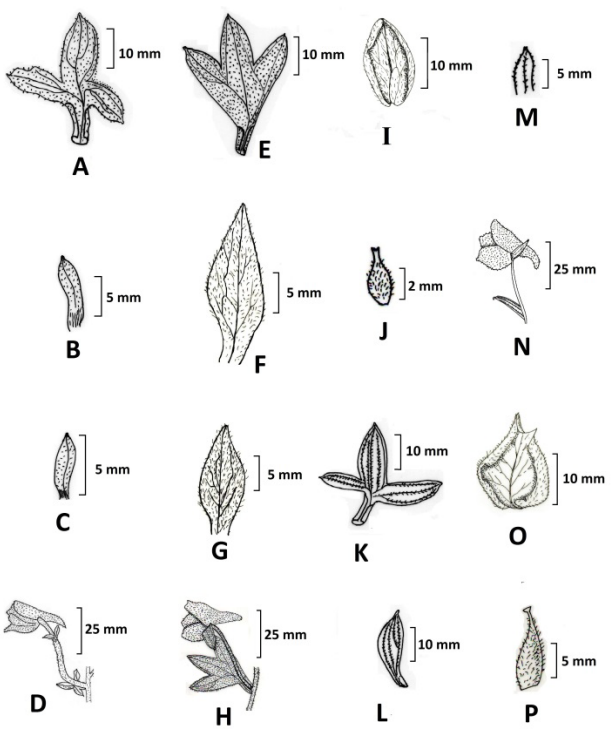


Fig. 1. A-D: ***Delphinium viscosum*** subsp. ***viscosum*** var. ***viscosum*** (Gammie 1143, CAL), showing bract (**A**), bracteole (**B, C**), and flower (**D**). **E-O**: ***D. viscosum*** subsp. ***gigantobracteum*** var. ***gigantobracteum*** (Kingdon-Ward 14329, BM), showing bract (**E**), braceole (**F, G**), flower (**H**), sepal (**I**), and carpel (**J**). **K-P**: ***D. viscosum*** subsp. ***chrysotrichum*** var. ***chrysotrichum*** (T. Husain & Party 257635, LWG), showing bract (**K**), bracteole (**L, M**), flower (**N**), sepal (**O**), and carpel (**P**).

Key to infra-specific taxa of *D. viscosum*

1a. Leaves deeply multilobed, scarcely hairy on dorsal surface; inflorescence solitary to very few flowered; bracts 1.8–2.0 cm long; bracteoles 0.7–0.8 cm long, distantly placed from flower; carpels glabrous…….…….. subsp. ***viscosum***

1b. Leaves trilobed, densely hairy on both surfaces; inflorescence many flowered; bracts 2.5–5.5 cm long, bracteoles 0.7–2.0 cm long, placed at the base of the flower; carpels completely hairy ……..
…….……2. subsp. ***gigantobracteum***

2a. Sepals densely hairy on both surfaces, greenish-yellow; carpels silky hairy, upto 5 mm long …..…….....……..var. ***gigantobracteum***

2b. Sepals densely hairy on outer surface, dull violet; carpels hirsute, upto 11 mm long ….....…….....var. ***chrysotrichum***

1. subsp. ***viscosum*** Fig. 1A-D

Phenology: July–October.

Distribution and ecology: It is distributed in Nepal, Bhutan, Tibet and India it is found in Sikkim, Arunachal Pradesh and W. Bengal. It is chiefly grown on the alpine slopes of the mountains, at an altitude ranging from 3600 up to 4000 m.

Notes: We could locate two type vouchers of *D. viscosum* one from BM and another from E collected by J.D. Hooker from Sikkim at an altitude of 15–16000 ft. Hook.f. and Thomson had mentioned this specimen as the type of *D .viscosum* without mentioning the herbarium in which

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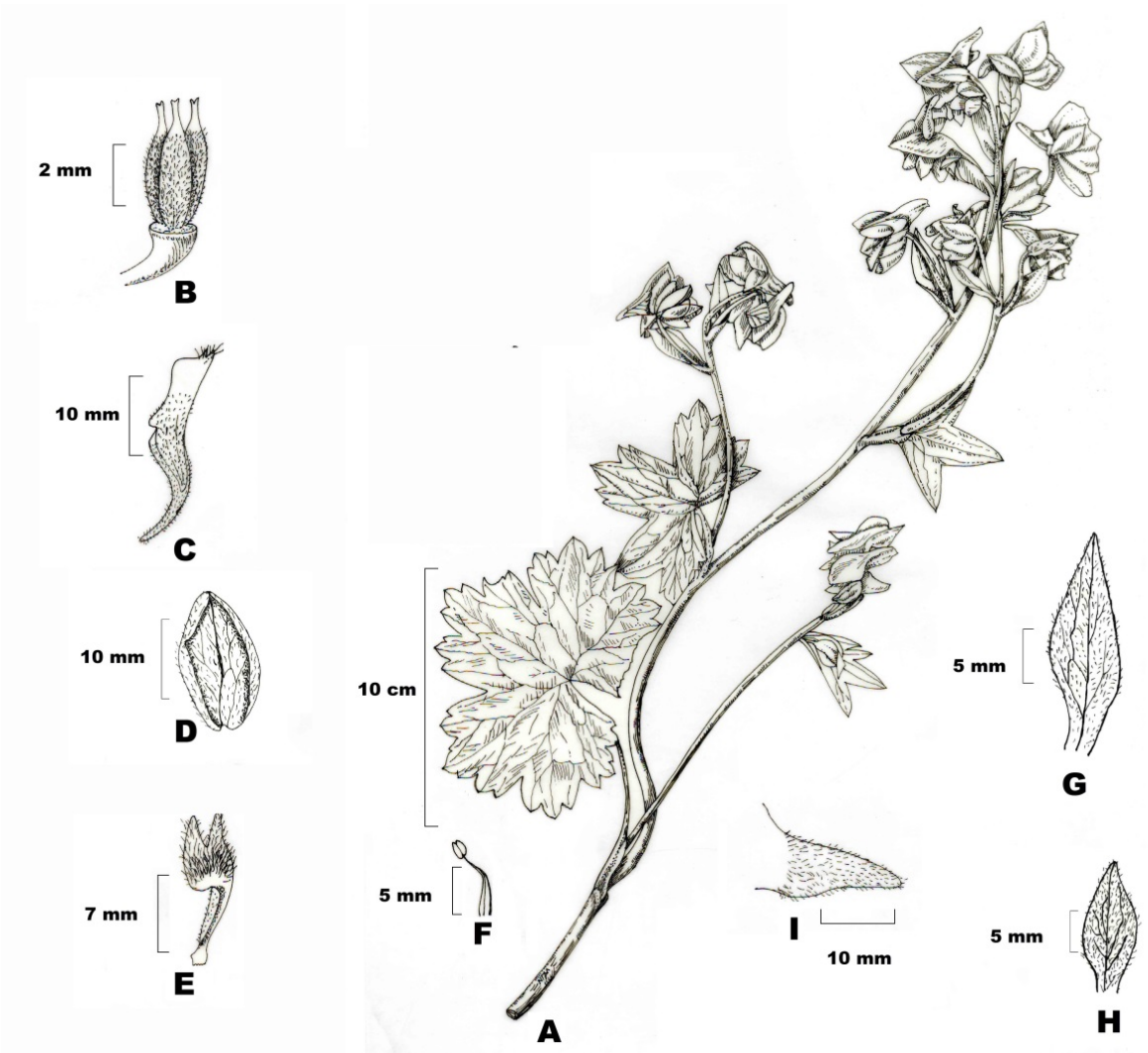


Fig. 2. ***Delphinium viscosum*** subsp. ***gigantobracteum***. **A**: Habit. **B**: Carpel. **C**: Petal. **D**: Sepal. **E**: Staminode. **F**: Stamen. **G**: Bract. **H**: Bracteole. **I**: Spur. (*T. Husain & Party 257635*, LWG).

the type specimen is deposited. The specimen in BM having three small twigs containing bracts, bracteoles and flowers and one separate leaf was designated by Munz (1967) as the type specimen, whereas the another specimen deposited in E is the isotype not the isosyntype as mentioned on the voucher specimen. The specimen collected by J.D. Hooker from Phutwang, near Tunga in Sikkim kept in type folder at K should not be confused with the type specimen. One more specimen of *D. viscosum* from Kinchin-Jhow is deposited in K having the petals and single staminode in a packet with the note, Lord Auckland's Islands Antart. Exp. 1839–1843 by J.D.Hooker, but it is not clear whether the proper specimen was collected by J.D. Hooker or not, as the date in both the collections is different. *D. trilobatum* and *D.viscosum* var. *ciliata*, var. *connectans* are treated as synonyms of *D. viscosum* in the present study as these taxa have the overlapping characters and cannot be kept apart.

Specimens examined: **INDIA:** Sikkim, Kinchin-Jhow, 16000 ft., 12 Sept. 1849 (K-photo seen). Sikkim, *Dr. King's Collector* (CAL). 8 Dec. 1903; *Dr. Prain's collector 279* (CAL). Sikkim: Sebu valley, 13000 ft., 5 Sept. 1892, *G.A. Gammie 1143* (CAL).

2. subsp. ***gigantobracteum*** (Bruhl ex Huth) Agnihotri, Husain, Singh & Husain, ***stat. nov.***

Fig.1E-H, & 1M & 1O; Fig.2

2a. **var. *gigantobracteum***

Delphinium viscosum var. *gigantobracteum* Bruhl ex Huth., Bot. Jahrb. 20: 401. 1895; Bruhl in Bruhl & King, Ann. Bot. Grad. Calc. 5: 104. 1896; Mukerjee in Bull. Bot. Surv. India 2(3–4): 293. 1960; Munz in J. Arn. Arb. 48(3): 495. f. 7. H & I. 1967. Type: **INDIA**: Sikkim: Chumbi, Kungbur, 7 Aug. 1884, *Dr. King's collector 42* (CAL); Sikkim, Zeylep La, Sept. 1879, *G. King* (CAL).

Delphinium aureopilosum Chowdhury in Mukerjee, Bull. Bot. Surv. India 2(3–4): 293. 1960. Type: **INDIA**: Sikkim: Nathu La, 14500 ft., 24 Aug. 1913, *R.E. Cooper 605* (E-photo seen).

Phenology: August–September.

Distribution and ecology: It is distributed in Nepal, Bhutan, Tibet and in India (Sikkim). It is mostly found

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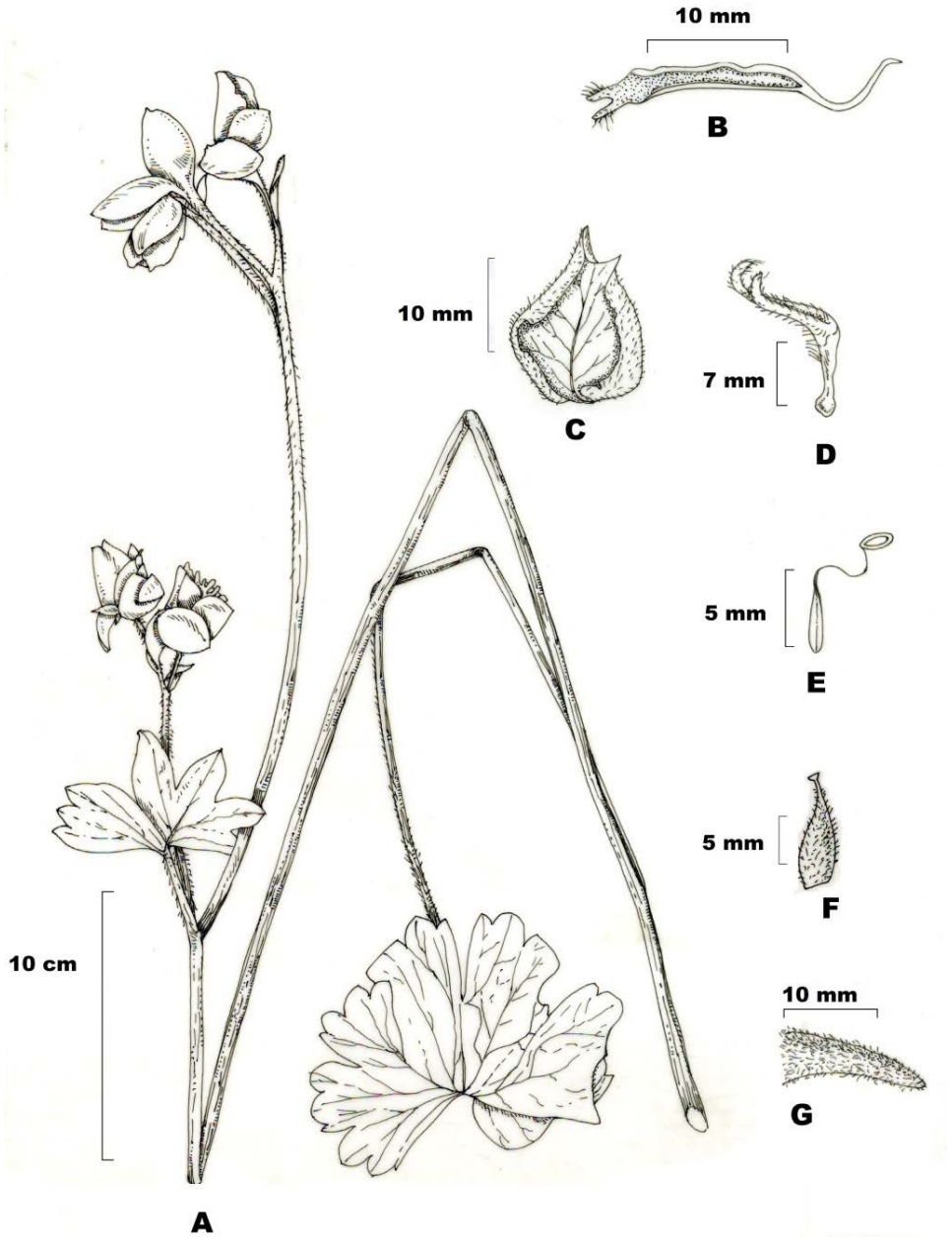


Fig. 3. ***Delphinium viscosum*** subsp. ***chrysotrichum***. **A**: Habit. **B**: Petal. **C**: Sepal. **D**: Staminode. **E**: Stamen. **F**: Carpel. **G**: Spur. (*Kingdon-Ward 14329*, BM).

on moist places along road side of the mountains, at an altitude ranging from 3600 upto 4000 m asl.

Specimens examined: ***INDIA:*** *Sikkim: Zeylep La, 14,000 ft., 14 Sept. 1945, Bor's collectors (DD). Zeylep La, 14 Oct. 1884, Dr. King's Collectors* (CAL). Zongpong Pastures, Sept. 1900, *Dr. Prain's Collectors 115* (CAL). Sept. 1905, *Dr. Prain's collectors* (CAL). Na-Tut, 28, Aug.1882, *G. King's Collector* (CAL). Below Zeylep, 13,800 ft., 16 Aug. 1910, *W.W. Smith 4341* (CAL). Kupup, 23 Aug. 1878, *Dungboo* (CAL). Zeylep La, 14 Oct. *Dr. King's Collectors* (CAL). Thegu, 3898 m., 12 Sept. 2014, *T. Husain & Party 257635* (LWG).

Notes: Munz (1967) treated *D. viscosum* var. *gigantobractea* of Bruhl as the synonym of *D. viscosum* without giving attention to the peculiar yellow colour of sepals unlike any other taxa in *Delphinium*, he had given a range of colour of sepals from violet to purplish blue, while in the var. *gigantobractea*, the colour of flower is pure dingy or greenish yellow without admixture of any tinge of blue or violet. While consulting the general collections of *Delphinium* specimens at CAL, we came across four vouchers of *D.viscosum* of Dr. King's collector, 2 from Chumbi, near Kungbur and 2 sheets from Sikkim, Zeylep La, these specimens were the syntypes for the *D. viscosum* var. *gigantobractea* (Bruhl,1896). The colour of the flower is clearly mentioned on the vouchers as yellowish green and dingy yellow. We have located one

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population and also collected specimens of *D.viscosum* with yellow flowers in east Sikkim with trilobed leaves, many flowered inflorescence, big bracts and hairy carpels, which matches with var. *gigantobractea*. Chowdhuri annotated a voucher specimen as *D. aureopilosum sp. nov.* collected by R.E. Cooper from Nathula, Sikkim deposited in E. Later on Mukerjee (1960) published *D. aureopilosum* (*nom. nud*.) with the possible distribution in Sikkim, Nepal and Tibet. The specimen was well collected and preserved with dissected parts affixed on the top of the sheet. On closure examination we could establish that this yellow flowering species is nothing else but *D. viscosum* subsp. *gigantobracteum* var. *gigantobracteum.*

2b. var. ***chrysotrichum*** (Bruhl ex Huth) Agnihotri, Husain, Singh & Husain, ***comb. nov.***

Fig. 1I-L, 1N & 1P& Fig.3 & 4

Delphinium viscosum var. *chrysotrichum* Bruhl ex Huth, Bot. Jahrb. 20: 401. 1895; Bruhl in Bruhl & King, Ann. Bot. Gard. Calc. 5: 104. 1896; Mukerjee in Bull. Bot. Surv. India 2(3–4): 293. 1960; Munz in J. Arn. Arb. 48(3): 495. f. 7. H & I. 1967. Type: **NEPAL**: Kanglanamo-Nyrpokri, Aug.–Sept. 1887, 13,000 ft., *Dr. King's Collector* (CAL) lectotype designated here; **INDIA**: Sikkim: Jongri District, *King's Collector* (CAL) paratype.

Delphinium conocentrum Chatterjee, Kew Bull., 3: 57. 1948. Type: **INDIA**: Sikkim: Jongri to Alaktong, 13–15,000 ft., 9 Oct.1862, *T. Anderson 345* (K); isotype: (E- photo seen).

Phenology: August–September.

Distribution and ecology: It is distributed in Nepal, Bhutan, Tibet and in India (Sikkim). It is found to grow in moist places in the alpine slopes of the mountains at an altitude ranging from 4000 upto 5000 m asl.

Specimens examined: **INDIA:** Sikkim: Thangu, 21 Sept. 1903, *Dr. Prain* (CAL); **NEPAL:** Neerpokri, 13,000 ft., August 1888, *Dr. King's Collectors* (CAL). **BHUTAN:** Orka La, 12,000 ft., 3 Nov. 38, *F. Kingdom Ward 14329* (BM).

Notes: We critically studied the type specimens of var. *chrysotrichum* of Dr. King's collectors from Kanglanamo, Nepal and Neerpokri, Sikkim kept in the general collection at CAL. One type voucher from E collected by T. Anderson from Jongri to Alaktong, Sikkim was determined by Chowdhary as *D. conocentrum* of Chatterjee confusing it to *D. trilobatum* because of trilobed leaves. Chatterjee (1948) described a new species *D. conocentrum* based on T. Anderson, no.345 specimen deposited at K, and compared this species with *D. viscosum* but overlooked var. *chrysotricha* of *D. viscosum*, which has the characters of *D. conocentrum.* Thus, we have kept *D. conocentrum* under *D. viscosum* subsp. *gigantobracteum* var. *chrysotrichum.*

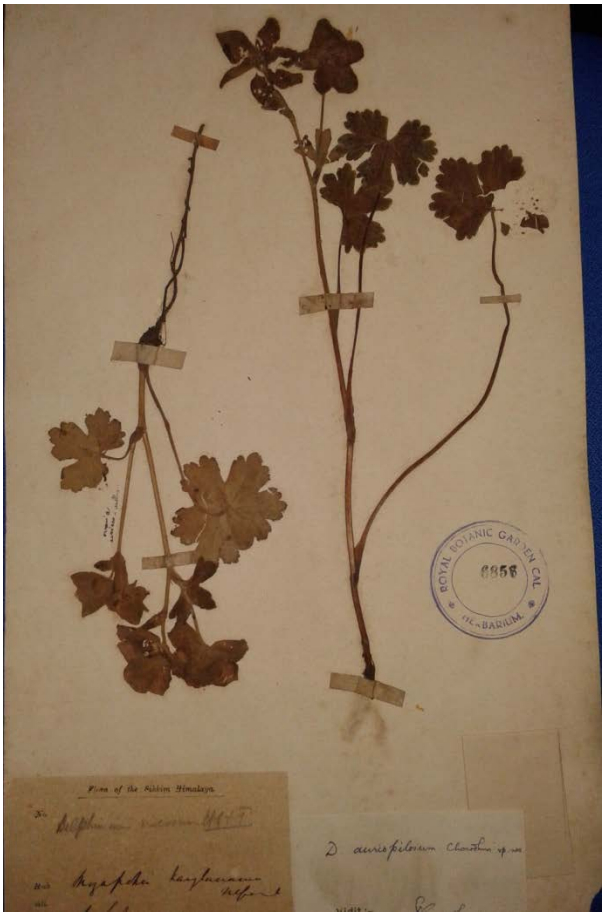


Fig. 4. Lectotype of ***Delphinium viscosum*** subsp. ***chrysotrichum***, *Dr. King's Collector* (CAL).

ACKNOWLEDGEMENTS

The authors are thankful to the Director, CSIR-NBRI, Lucknow, India for facilities and encouragement, we are also grateful to the Curators of The Natural History Museum, London (BM), Central National Herbarium, Howrah (CAL), Forest Research Institute, Dehradun (DD) from which the specimens were borrowed on loan. Thanks are due to Department of Science and Technology, New Delhi for financial assistance under Science and Engineering Research Board.

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