

# Koulium Genus nov. and Koulium psammogetifolium Sp. nov. (Apiaceae; Pimpinelleae) from Jammu, India

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## Abstract

*Koulium*, a newly discovered monotypic genus of the family Apiaceae from the south-west of Jammu, Jammu and Kashmir, India, is described and illustrated. It thrives in open areas, wastelands along rivers, and sandy beds. The new genus is related to *Aphanopleura*, *Psammogeton*, and *Pimpinella* but differs from them in that it has a thick, deep yellow root, fruits with intermixed hairs that are simple and T-shaped, petals sparsely pubescent on the outside, small vittae that are one under each furrow, ridges obscure, and fruits that have a subpentagonal cross section, oblong or elliptic, broader above, gradually narrow below. A diagnostic key, photos, illustrations, a distribution map, comparative characteristics (Table 1), and its closely related genera are provided.

## Introduction

Approximately 466 genera and 3820 species comprise up the Apiaceae, which are widely spread in temperate Eurasia and North America (Plunkett et al. 2018). According to Mukherjee and Constance (1993), there are 240 species and 68 genera in the genus in India. India is home to seven endemic genera of the family Apiaceae, including *Karnataka* P. K. Mukh. & Constance, *Kedarnatha* P. K. Mukh. & Constance, *Polzygygus* Dalzell, *Sivadasania* Mohanan & Pimenov, *Vanasushava* P. K. Mukh. & Constance, *Shrirangia* Gosavi, Madhav & Chandore and *Pinda* P. K. Mukh. & Constance. Fruit and petal hairiness are unique characteristics worthy of special mention. These morphological characters are unknown to any other genus in combination.

One of the authors (BLB) gathered a few intriguing Apiaceae specimens while doing a floristic study of Jammu and Kashmir. These specimens resembled *Psammogeton* species in appearance. These specimens were discovered to be distinct from their sister taxa, namely *Psammogeton*, *Aphanopleura*, and *Pimpinella*, after rigorous examination in the Government College for Women's Life Sciences Research Lab in Parade Ground, Jammu. However, the unidentified genus had some similarities to other genera such as *Pimpinella*, *Psammogeton*, and *Aphanopleura* of the tribe Pimpinelleae of Apiaceae. Based on the characteristics of fruit form, indumentum and its variants, carpophore, stigmas, fruits straw coloured, sparsely hairy, shining fruit, and sparsely hairy petals. The shape of fruit elliptic, oblong, and oblanceolate, with the ridges being obscure. Additionally, considering some more overall points of difference (Table 1), it is proven that we had discovered a new genus.

Perusal of floristic literature Boissier (1872), Drude (1898), Clarke (1879), Kitamura (1960), Heywood and Dakshini (1971), Babu (1977), Sharma and Kachroo (1981), Mukherjee and Constance (1983, 1986, 1993), Rechinger (1987), Pimenov and Leonov (1993, 2004), Katz-Downie et al. (1999), Ohba (1999), Downie et al. (2000, 2010), Zakharova et al. (2012), Yesil et al. (2018), Pimenov et al. (2019), Mousavi et al. (2022), Gosavi et al. (2020, 2022) reveal each made finding regarding the genera and species of this family that differed from what was previously known.

## Material and Methods

One of the authors discovered some intriguing specimens in Jammu and Kashmir in 2022 while conducting a field study that were remarkably similar to *Psammogeton*. These specimens were discovered to be very distinct from *Psammogeton* species after thorough analysis in the Life Science Research Lab of the Government College for Women, Parade Ground. The specimens were mounted on the herbarium sheets using the accepted technique (Jain and Rao 1977). The pictures were produced with the help of a binocular stereoscope. Parts of the specimens, particularly the blooms, were cooked in warm water for a minute to enable stereoscopic observations. All measurements are from herbarium and live specimens. According to descriptions in the taxonomic literature (Boissier 1872, Clarke 1879, Hiroe and Constance 1958, Kitamura 1960, Nasir 1972, Babu 1977, Sharma and Kachroo 1981, Hedge et al. 1987, Assadi et al. 2008, Ghazanfar and Edmondson 2013, Pimenov et al. 2019) and comparison with the herbarium specimens in POWO 2023 and different herbaria including K, RRLH, and E, following Thiers (2015) revealed that specimens indeed represent new taxa both genus as species. The terminology is used following (Kljuykov et al. 2004, Hickey and King, 2007).

## Taxonomy

*Koulium* Gen. nov.

**Type species:** *Koulium psammogetifolium* sp. nov.

## Description of the genus

Annual, glabrous or pubescent, small herbs. Leaves usually 1-pinnate, pinnae toothed or lobed. Inflorescence terminal or axillary leaf-opposed umbels. Peduncles glabrous or pubescent. Rays 3-10, glabrous or pubescent. Bracts 3-5, margins scarious, ciliate; bracteoles 5-6, papery, margins ciliate. Flowers white or pale purple. Calyx-teeth reduced, adnate to ovary wall. Corolla with 5 petals, obovate or obcordate, emerginate with long pointed tip. Stamens 5, filaments long, anthers bithecous, hairy at base. Fruits oblong, oblanceolate, pubescent or glabrescent, ridges obscure, unwinged furrows, vittae usually one carpophore, bifid, mericarps dorsally compressed, hairs simple intermixed with a few T-shaped.

## Etymology

The generic name honours Prof. A. K. Koul, FNASC an eminent Indian botanist for his contribution in taxonomy, cytotaxonomy and biodiversity conservation.

**Table 1. Morphological comparison between the genus *Koulium* and its closely allied *Psammogeton* and *Aphanopleura***

Chracter	<i>Koulium</i>	<i>Psammogeton</i>	<i>Aphanopleura</i>
Habit	Annual	Annual	Annual
Root	Thick, deep yellow	Thick, white to pale	Thin, white to pale
Bracts (number)	bracts 3-5	Bracts 5-8	Bracts 2-5
Bracteoles (number)	bracteoles 5-6	Bracteoles 6-6	Bracteoles 5-6
Petiole base	Narrowly sheathy	Conspicuously sheathy	Narrowly sheathy
Rays (number)	Rays 3-10	Rays 2-20	Rays 5-10
Petals (indumentum)	margins and outside hairy Glabrous	margins and outside hairy Glabrous	Glabrous
Stigma	linear or nearly so	Capitate	Capitate
Carpophore	Bifid	Bifid	Bifid
Fruit (upper portion)	Conspicuously broader	Slightly narrow	Slightly narrow
Vittae (furrow of fruit)	One	One	One
Fruit ridges	Obscure	Winged or elevated	Rounded or obscure
Mericaip (outer face)	Dorsally compressed	Dorsally compressed	Laterally compressed
Fruit hair type	Simple with few T-shaped	T-shaped	T-shaped

## Key to *Koulium* and to its related Asian genera

1. Calyx-teeth conspicuous —————

*Cuminum*

– Calyx-teeth reduced ————— - 2

2. Primary ridges of fruits eight —————

*Turgenia*

– Primary ridges of fruits five ————— - 3

3. Fruits clothed with spiny bristles —————

*Torilis*

– Fruits clothed with soft pubescence, bristles or T-shaped hairs ————— - 4

5. Plants 1-3 m tall ————— - 6

– Plants smaller ————— - 8

6. Leaves all radical, unipinnatisect —————

*Demavendia*

– Leaves radical and cauline —————

**7**

7. Plants glabrous, 2-3 m tall —————

*Haussknechtii*

– Plants pubescent 1-2 m tall —————

*Zeravschania*

8. Plants perennial; fruit furrow with 2-3-vittae —————

*Pimpinella*

– Plants annual; fruit furrow usually with 1-vittae ————— - 9.

9. Roots thin; mericarps laterally compressed; fruit hair clavate ————— *Aphanopleura*

– Roots thick; mericarps dorsally compressed; fruit hair straight ————— - 10

10. Petiole conspicuously sheathed, distinctly hairy; petals glabrous; fruits narrow on both ends, swollen in the middle; fruit hair dense, T-shaped —————

*Psammogeton*

– Petiole narrowly sheathed, sparsely hairy; petals sparsely hairy on margins and on outside; fruits oblanceolate, narrow below gradually broader above, hair sparse, simple usually simple hairy, intermixed with few T-shaped hair —————

*Koulium*

## Affanities

The petals are obcordate and emerginate, the stamens are inflexed in the bud, and the calyx attaches to the ovary wall. The corophore is bifid, the commissure is slightly constricted, and the fruits are laterally or dorsally compressed, but they differ in size, shape, and indumentum. Due to the large number of species,

*Pimpinella* 's fruits might be elliptic, oblong, ovoid, cylindrical, or obovoid in form. The forms are ovoid, oblong, and ovoid-oblong because *Psammogeton* and *Aphanopleura* have fewer species than other genera.

*Psammogeton* , *Aphanopleura* , and *Pimpinella* are the closely related genera that exhibit affinities with one another. In contrast to *Aphanopleura* and *Psammogeton* , which are annuals and *Pimpinella* L., *Demavendia* , *Haussknechtii* , *Zeraveschonia* are perennials. The leaves of *Psammogeton* and *Aphanopleura* species closely resemble to the genus *Koulium* , and all these three genera are annuals. Additionally, the new genus is closely related to *Psammogeton* by virtue of its thick root while as the root is considered as thin in *Aphanopleura* . The fruits the genus *Koulium* progressively get narrower below and wider above that share some characters with the genus *Pimpinella* . The genus *Koulium* is allied to *Psammogeton* , *Aphanopleura* and *Pimpinella* but distinguished from them as in Table 1 and key below. The new genus is annual which is distinct from other genera being perennial such as *Demavendia* , *Haussknechtii* , *Pimpinella* and *Zeraveschonia* . The study we conducted revealed that *Aphanopleura* and *Psammogeton* both retain 46 % of genus' similarity with *Koulium* while as *Pimpinella* shares 30 %.

*Koulium psammogetifolium* sp. nov. (Fig. 1-5)

**Type:** India, Jammu and Kashmir, district Jammu, south-west, Mandal, 32° 6795 N 74° 7460 E, 285 m a.s.l. 27 Apr 2022, B. L. Bhellum 15784 (holotype – –)

The specific epithet '*psammogetifolium*' refers to leaves of the new species that resemble with *Psammogeton* species.

### Description of species

Annual, erect, 3-10 cm tall herbs. Root thick at base gradually narrow towards apex, slightly angular, deep yellow. stem much branched from the base, branches hollow, hollow, nodes prominent, glabrous. Radical leaves numerous, leaf-base sheathy, minutely hairy, 1-2-pinnate, leaf-segments 3-5 mm long, ternately lobbed, sparsely pubescent, drying at anthesis; cauline leaves similar, smaller, petiole short, narrowly sheathy-base, sparsely short hairy on margins, usually 1-pinnate, each segment ternately lobed, pubescent. Inflorescence terminal and axillary leaf-opposed umbels. umbellets — flowered. Peduncle ribbed, glabrous. Rays 3-7, unequal, peripheral longer than the inner ones. Involucre of 5, 2.5-3.5 mm long bracts broader in the middle and narrow at tip, long pointed, margin scarious, ciliate, minutely hairy green midrib. Involucel of 2-2.4 mm long, obovate, oblong, transparent, membranous bractlets, pubescent along midrib, distinctly ciliate along margins. Flower pedicellate, pedicel 2.0-3.1 mm long, bisexual, 2.7-3.2 mm long, white tinged pale purple. Calyx-teeth reduced. Corolla polypetalous, petals 5, obovate to obcordate, emerginate, sparsely hairy on margins and outside, outer petal slightly rotate, 2.7-3.2 mm long, white tinged pale purple, inflexed, tip long pointed. Stamens 5, free, filament 3-4 mm long, alternipetalous, inflexed in bud, slightly longer than petals; anthers bitheous, adnate, yellow, hairy near the base, dehiscence longitudinal; pollen grains subrectangular, rugulate at the equatorial region, exine thicker at the equatorial zone. Ovary bicarpellary syncarpous, inferior, bilocular, sparsely hairy; styles two, 1-1.4 mm long, persistent; stigmas two, slightly swollen, not capitate. stylopodium swollen at base, progressively become thin upwards, crowning the ovary, persistent. Fruit a schizocarp, 2-3 mm long, 0.5-1.2 mm wide, elliptic oblong, narrow at base, gradually turning wide above, persistent, mericarps two, dorsally compressed, primary and secondary ribs obscure, sparsely hairy with simple hair and a few intermixed with T-shaped hair with conspicuous thick base, green, turning straw-coloured, shining.

### Phenology

Flowering and fruiting period from March to May

### Habitat, distribution and ecology

A species grows on an admixture of sandy and clayey soil. The species is found in association with *Argyrololium roseum* (Camb.) Jaub. & Spach., *Alternanthera pungens* H. B. & K. *Artemisia capillaris* Thunb., *Calotis hispidula* F. Muell., *Cyperus rotundus* L., *Evolvulus alsinoides* (L.) L., *Heterolobium strigosum*



Willd., *Indigofera linnaei* Ali, *I. linifolia* Retz., *Laggera aurita* Sch.-Bip., *Mazus delavayi* Bonati, *Mecardonia procumbens* Small, *Spermacoce ramnii* Sivarajan & Nair, *Synedrella vialis*, *Tilia pharnaceoides* Hochst. ex Brit., *Verbascum thapsus* L., *Verbesina encelioides* Benth.

## Conservation status

*Koulium psammogetifolium* occurs on sandy places and somewhat disturbed habitat along the river bank. The species is known from the type locality Jammu, Jammu and Kashmir, India. According to IUCN (2022) guidelines, the recommended IUCN status is data deficient (DD).

## Discussion and Conclusion

Due to the presence of a yellow tap root, sheathed leaf base, calyx reduced, petals sparsely pubescent, anthers hairy at base, stigmas linear, fruits intermixed with simple and T-shaped hair, the new taxon is classified as belonging to the genus *Koulium* section *Pimpinelleae* of the *Apiaceae* family. Membranous, scabrous, and with ciliate edges, bracts and bracteoles. Stipules are missing, and the bases of the petioles are narrowly sheathed. Reduced and joined to the ovary wall are the calyx. White or pinkish-purple petals. The form seems obcordate and emergent. The fruits are compressed dorsally. Furrows in the pericarp typically include vittae. Fruits have hairy primary and secondary ridges are obscure. Carpels have a subpentagonal cross section, bifid carpophores, and modestly constrained commissures. On the simple, T-shaped fruits of this species, which also have wider bases, we discover hair admixture. The fruit hairs of *Aphanopleura* and *Psammogeton* have a T shape. The shape of the fruit being oblong-cylindric becoming gradually narrow towards base which are to some extent similar to *Pimpinella* species, however, it differs from them in sparsely hairy petals on outside and on margins and annual in habit.

## Additional specimens examined (Paratype)

India, Jammu and Kashmir, District Jammu, Mandal, 32° 6' 795 N 74° 7' 460 E, 285 m a. s. l. 27 Apr 2022, B. L. Bhellum 15786 (—).

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## Conflict of interest statement

The authors declare no any potential source of conflict of interest.

## References

- Assadi, M. et al. 2008. Flora of Iran. Vol. 1–60. – Research Institute of Forests and Rangelands, Tehran (in Persian).
- Babu, C. R. 1977. Herbaceous Flora of Dehra Dun. – Publication and Information Division (CSIR), New Delhi.
- Boissier, E. 1872. Umbelliferae. In: Boissier, E. (ed.) Flora Orientalis, Vol 2. – H. Georg, Geneva & Basileae, pp. 819–1090.
- Downie, S. R. et al. 2000 Molecular systematics of Old World Apioideae (Apiaceae): relationships among some members of tribe Peucedaneae sensu lato, the placement of several island-endemic species, and resolution within the apioid superclade. – *Canad. J. Bot.* 78:506–528. <https://doi.org/10.1139/b00-029>.
- Downie, S. R. et al. 2010. Major clades within Apiaceae subfamily Apioideae as inferred by phylogenetic analysis of nrDNA ITS sequences. – *Plant Div. Evol.* 128: 111–136. <https://doi.org/10.1127/1869-6155/2010/0128-0005>.
- Drude, O. 1898. Umbelliferae. In: Engler A, Prantl K (eds) Die natürlichen Pflanzenfamilien, vol. 3. – Wilhelm Engelmann, Leipzig, pp 63–250.
- Ghazanfar, S. A. and Edmondson, J. R. (eds.) 2013. Flora of Iraq. 5(2): 1–349. – Ministry of Agriculture and Agrarian reforms, Baghdad.

- Gosavi, K. V. C. et al. 2020. *Pinda shrirangii*, a new elegant species of Apiaceae from the northern Western Ghats, India. – Nord. J. Bot. 2020: e02771. doi: 10.1111/njb.02771.
- Gosavi, K. V. C. et al. 2022. *Shrirangia*: a new genus of Apiaceae from lateritic plateaus of Konkan region of Maharashtra, India. – Nord. J. Bot. 2022: e03442. doi: 10.1111/njb.03442.
- Hedge, I. C. et al. Umbelliferae 1987. In: Rechinger, K. H. (ed.), Flora Iranica 162: 1–555. – Akademische Druck 4. Verlagsanstalt, Graz.
- Heywood, V. H. and Dakshini, K. M. M. 1971. Fruit structure in the Umbelliferae – Caucalideae. In: Heywood, V. H. (ed.), The Biology, Chemistry of the Umbelliferae, London. pp. 217–232.
- Hickey, M. and King, C. 2007. The Cambridge illustrated glossary of botanical terms. Cambridge: Cambridge University Press.
- Hiroe, M and Constance, L. 1958. Umbelliferae of Japan. – Univ. Calif. Publ. Bot. 31: 1–144.
- IUCN. 2022. Guidelines for using the IUCN Red List Categories and Criteria are regularly updated: the current version 15.1 prepared by the standard and petition committee, Cambridge. – <http://www.iucnredlist.org/resources/redlistguidelines>.
- Jain, S. K. and Rao, R. R. 1977. A Handbook of Field and Herbarium methods. – Today & Tomorrow's Printers and Publishers, New Delhi.
- Katz-Downie, D. S. et al. 1999. Towards a molecular phylogeny of Apicaceae subfamily Apioideae: additional information from nuclear ribosomal DNA ITS sequences. – Pl. Syst. Evol. 216: 167–195. – <https://doi.org/10.1007/BF01084397>.
- Kitamura, S. 1960. Flora of Afghanistan. – Kyoto University Nissha Printing Co. Ltd. Japan.
- Kljuykov, E. V., Liu, M., Ostroumova, T. A., Pimenov, M. G., Tilney, P. M. and Wyk van B-E. 2004. Towards a standard terminology for taxonomically important morphological characters in the Umbelliferae. South African Journal of Botany 70(3) 488–496
- Metcalfe, C. R. and Chalk, L. 1979. Anatomy of Dicotyledons. 2nd. Edition, Clarendon Press, Oxford.
- Mohanan, N. and Pimenov, M. G. 2007. A new genus of Apiaceae from Peninsular India. – Botanicheskii Zhurnal 92: 900–905.
- Mousavi, S. S., Mozaffarian, V., Mummenhoff, K., Downie, S. R. and Zarre, S. 2022. Systematic of Iranian genera *Aphanopleura*, *Demavendia*, *Haussknechtia*, *Psammogeton* and *Zerauschania* (Apiaceae tribe Pimpinelleae. Plant Syst & Evol 308(2): 2022. <https://doi.org/10.1007/s00606-021-01792-x>
- Mukherjee, P. K. 1983. Distribution and collection of rare Umbellifers in India, In: Jain, S. K. and Rao, R. R. An assessment of threatened plants of India. Botanical Survey of India. pp. 202–206.
- Mukherjee, P. K. and Constance, L. 1986. Two new genera of Indian Umbelliferae – Apiaceae – Brittonia 38: 145–149.
- Mukherjee, P. K. and Constance, L. 1993. Umbelliferae (Apiaceae) of India. – Oxford and IBH Publ. Co., New Delhi.
- Nasir, E. 1972. Umbelliferae In: Nasir, E. and Ali, S. I. (eds.) Flora of West Pakistan. 20: 1–169. – Ferozsons Ltd. Rawalpindi.
- Ohba, H. 1999. Umbelliferae In: Iwatsuki, K. et al. (ed.) Flora of Japan vol. 2. – Kodansha, Tokyo pp. 268–303.
- Pimenov, M. G. 2017. Updated checklist of Chinese Umbelliferae: nomenclature synonyms, typification, distribution. – Turczaninowia 20: 106–239.

- Pimenov, M. G. and Leonov, E. V. 1993. The genera of Umbelliferae. – R. Bot. Gard. Kew.
- Pimenov, M. G. and Leonov, E. V. 2004. The Asian Umbelliferae Biodiversity Database (ASIUM) with particular reference to south Asian taxa. – Turk. J. Bot. 28: 139–145.
- Pimenov, M. G. et al. 2019. What is *Seseli diffusum* ? A comparative morphological and molecular appraisal of critical species of Umbelliferae. – Plant Syst. Evol. 305: 49–59.
- Plunkett, G. M. et al. 2018. Apiaceae. – In: Kubitzki, K. (ed.) The families and genera of flowering plants, vol. XV. Springer, pp. 09–206.
- POWO. 2023. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Available from: <http://www.plantsoftheworldonline.org/> (accessed on: 06 June 2023)
- Rechinger, K. H. 1987. Flora Iranica 162: 144. – Akademische Druck-u. Verlagsanstalt.
- Sharma, B. M. and Kachroo, P. 1981. Flora of Jammu and Plants of neighbourhood. Vol. I. – Bishen Singh Mahendra Pal Singh, Dehra Dun.
- Thiers, B. 2015. Index Herbariorum: a global directory of public herbaria and associated staff. – New York Botanical Gardens's Virtual Herbarium. <http://sweetgum.nybg.org/science/ih>
- Yesil, Y, Akalin, E., Akpulat, A. and Vural, C. 2018. Fruit morphology of the genus *Pimpinella* (Apiaceae) in Turkey – Anales del Jardin Botanico de Madrid 75(2): e072. <https://doi.org/10.3989/ajbm.2509>
- Zakharova, E. A., Degtjareva, G. V. and Pimenov, M. G. 2012. Redefined generic limits of *Carum* (Umbelliferae, Apioideae) and new systematic placement of some of its taxa. Willdenowia 42: 149–168. <https://doi.org/10.3372/wi.42.42201>











