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Desert species *Tribulus cistoides* (Zygophyllaceae), rediscovery in India after 150 years

C. S. Purohit^{1,2*}, A. Kumar^{1,3}, S. L. Meena^{1,4}

¹ Arid Zone Regional Centre, Shubhashnagar, 77/80, Jodhpur, Rajasthan, 342014, India.

² E-mail: chandansinghpurohit@yahoo.com; ORCID ID: <https://orcid.org/0000-0003-4569-0511>

³ E-mail: kramitbsi@gmail.com; ORCID ID: <https://orcid.org/0009-0008-0015-4540>

⁴ E-mail: drslmeena.bsi@gmail.com

*Corresponding author

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Summary. *Tribulus cistoides* is rediscovered after 150 years in India from the Sikar district in the Rajasthan State. This study also reported first natural location of this species for flora of India since no one has reported its occurrence in wild in India. The species is closely allied to *T. terrestris* and *T. rajasthanensis* but differs in having larger flower with longer style and 2 larger and 2 shorter spines. The authors suggest calculating its IUCN status on the basis of IUCN red list criteria. For this purpose, more field exploration surveys with detailed studies are needed to know its status in India, particularly in arid and semi-arid regions.

The genus *Tribulus* belonging to family Zygophyllaceae is represented in India by 6 species and 3 varieties. The present paper envisages with its taxonomic description, photo plates, distribution map and identification key with their closely allied species for easy identification.

Пустынный вид *Tribulus cistoides* (Zygophyllaceae): повторное нахождение в Индии спустя 150 лет

К. С. Пурохит, А. Кумар, С. Л. Мина

Региональный центр засушливой зоны, Шубхашнагар, 775/80, Джодхпур, Раджастан, 342014, Индия.

Ключевые слова: Великая индийская пустыня, Индия, МСОП, Раджастан, Сикар.

Аннотация. Спустя 150 лет *Tribulus cistoides* повторно найден в Индии в районе Сикар в штате Раджастан. Это первая находка данного вида в стране в естественном местообитании. Вид наиболее близок к *T. terrestris* и *T. rajasthanensis*, но отличается более крупным цветком с более длинным столбиком, двумя более крупными и более короткими шипами. Природоохранный статус *T. terrestris* в Индии нуждается в уточнении и пока не может быть определён на основе критериев Красного списка МСОП. Для этой цели необходимы и рекомендованы дополнительные полевые исследования, особенно в засушливых и полузасушливых районах страны. Таким образом, род *Tribulus*, принадлежащий к семейству Zygophyllaceae, представлен в Индии 6 видами и 3 разновидностями. В настоящей статье представлено описание *T. cistoides*, фотографии, карта распространения и идентификационный ключ для соответствующей группы родства рода *Tribulus*.

Introduction

Thar Desert or the Great Indian Desert is situated in the arid western part of Rajasthan State of India and includes the adjoining sandy areas of Pakistan up to the Indus River. It forms a distinct but integral part of the arid lands of western India that runs through the state of Punjab, Haryana, Rajasthan and Gujarat. The eastern limit of Thar Desert is defined by the moisture availability index, which divides the arid from semi-arid tract. This boundary roughly passes through the foothills of the degraded Aravalli Hills Range through Rajasthan. In the west, the desert extends up to the fertile alluvial plains of the Indus River in Pakistan. In the South, the Thar boundary lies along the Great Rann of Kachchh (GRK) and the sandy plain and sand dunes system of north Gujarat. About 85 % of Thar Desert is located within India and it covers about 170 000 km². This area, consisting of sandy and saline plains, is the driest part of the state having thorny scrub type vegetation. Total angiosperm flora of western Rajasthan, including both indigenous and naturalised plants, comprises about 775 species and 48 varieties belonging to 384 genera under 90 families (Jain, 1972; Bhandari, 1990). Beside this, there are about 50 taxa of Angiosperms and one species of Gymnosperm which are considered to be rare and threatened in Rajasthan (Pandey et al., 1983; Kumar, Purohit, 2015; Kumar et al., 2017).

The genus *Tribulus* was established by Linnaeus (1753) and represented by ca. 30 species (POWO, 2025) and mainly distributed in warm areas of all continents (Salamon et al., 2006; Chhatre et al., 2014). Out of which 4 species and 3 varieties are reported from India namely *Tribulus pentandrus* Forssk. (three varieties i. e. var. *pterophorus*, var. *pentandrus*, var. *macropterus*), *T. rajasthanensis* Bhandari et V. S. Sharma, *T. subramanyamii* P. Singh, G. S. Giri, V. Singh and *T. terrestris* L. (Mao, Dash, 2020) and recently one species i. e. *T. ochroleucus* (Maire) Ozenda et Quezel has been reported from India by Ravikumar et al. (2022).

Tribulus cistoides L. was first described by Linnaeus (1753). It is annual or perennial herb, which prefers to grow along the tropical coasts (Holm et al., 1977), and native to tropical and subtropical southern Africa.

King (1879) was the pioneer explorer of Indian desert and compiled notes on Famine food of Marwar with sketch flora of Rajputana. After that, Brandis (1874) described forest plant species of Rajputana in forest flora of North-west and Central

India. A number of workers (Duthie, 1888; Blatter, Hallberg, 1918–1921; Sankhla, 1951; Pandey, Shetty, 1985; Parmar et al., 1985; Shetty, Singh, 1987–1993; Bhandari, 1990; Singh, Pandey, 1997; Kumar, Purohit, 2015; Kumar et al., 2017; Purohit, 2020a, b) have contributed to the flora of different regions of Rajasthan.

Materials and Methods

During one botanical exploration trip to Indian desert, authors collected some interesting specimens of genus *Tribulus* from Maonda locality of the Sikar District, Rajasthan (Fig. 1), which at first glance seemed different from its other species. It had bigger flower and different mericarps spines characters than those of its closest allies *Tribulus terrestris* L. Critical study on the vegetative as well as flowering stages of the collected specimens and scrutiny of literature (Edgeworth, Hooker, 1874; Shukla, 1971; Ghafoor, 1974; Nayar, Giri, 1982; Pandey et al., 1983; Bhandari, 1990; Shu-Miaw et al., 1993; Singh P., Singh V., 1997; Ahmed, Mohamed, 2005; Thomas, 2006; Vélez-Gavilán, 2022), revealed unreported species *Tribulus cistoides* L. in the Indian flora from Indian desert. Specimens are deposited in herbarium of Botanical Survey of India, Arid Zone Regional Centre, Jodhpur (BSJO). The same is reported here for the first time along with its extended distribution and differentiation with its allied species. The taxonomic key, taxonomic description, macro and micro photographs, distribution maps and other relevant details are also provided.

Result and Discussion

The taxonomic keys, detailed description, distribution, distribution maps and photo-plates of *Tribulus cistoides* are provided here for its easy identification.

Key for *Tribulus cistoides* and related species

1. Mericarps either winged or spinous 2
+ Mericarps not winged or not spinous
..... *T. ochroleucus*
2. Mericarps winged, not spinous
..... *T. pentandrus*
+ Mericarp not winged but spinous 3
3. Flowers smaller, 7–15 mm 4
+ Flower larger, 25–40 mm diam. *T. cistoides*
4. Mericarps with 2 lateral and two basal spines 5

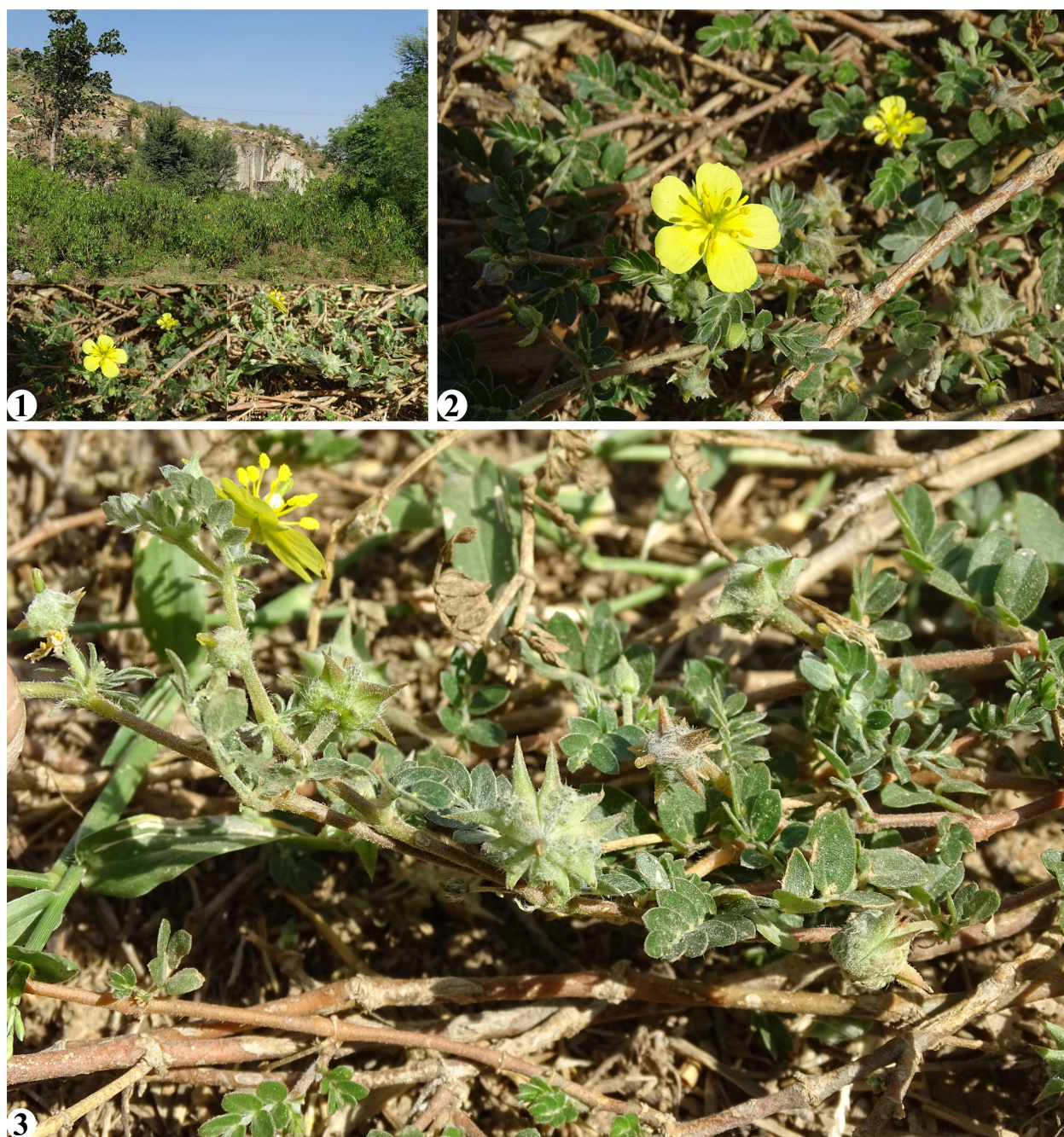


Fig. 1. Field view of *Tribulus cistoides* L. in Sikar, Rajasthan.

- + Mericarps with two lateral spines and 20–25 unequal spines spreading throughout *T. rajasthanensis*
- 5. Leaflets oblong; style inconspicuous or hardly 0.5 mm long *T. terrestris*
- + Leaflets ovate-oblong or ovate-orbicular; style 1.5–2.5 mm long 6
- 6. Style puberulous, intrastaminal glands connate and ciliated *T. subramanyamii*
- + Style glabrous, intrastaminal glands free not ciliated *T. lanuginosus*

***Tribulus cistoides* L.:** “Rajasthan, Sikar, Maonda, 27°42'21.03"N, 75°47'45.42"E, 463.6 m. 23 X 2023. C. S. Purohit, Amit Kumar. 38220” (BSJO); “Kolkata, Howrah, Indian Botanical Garden” (CAL 66742) (Fig. 1, 2). – Salient features: a prostrate hirsute plant with deltoid stipules; leaves opposite with cordate base; flower larger with bright yellow colour; mericarps 5, each bearing two lateral stout spines. Flowering and Fruiting: Aug. – Nov.

Distribution. Native to tropical and subtropical southern Africa and widely naturalized pantropically,

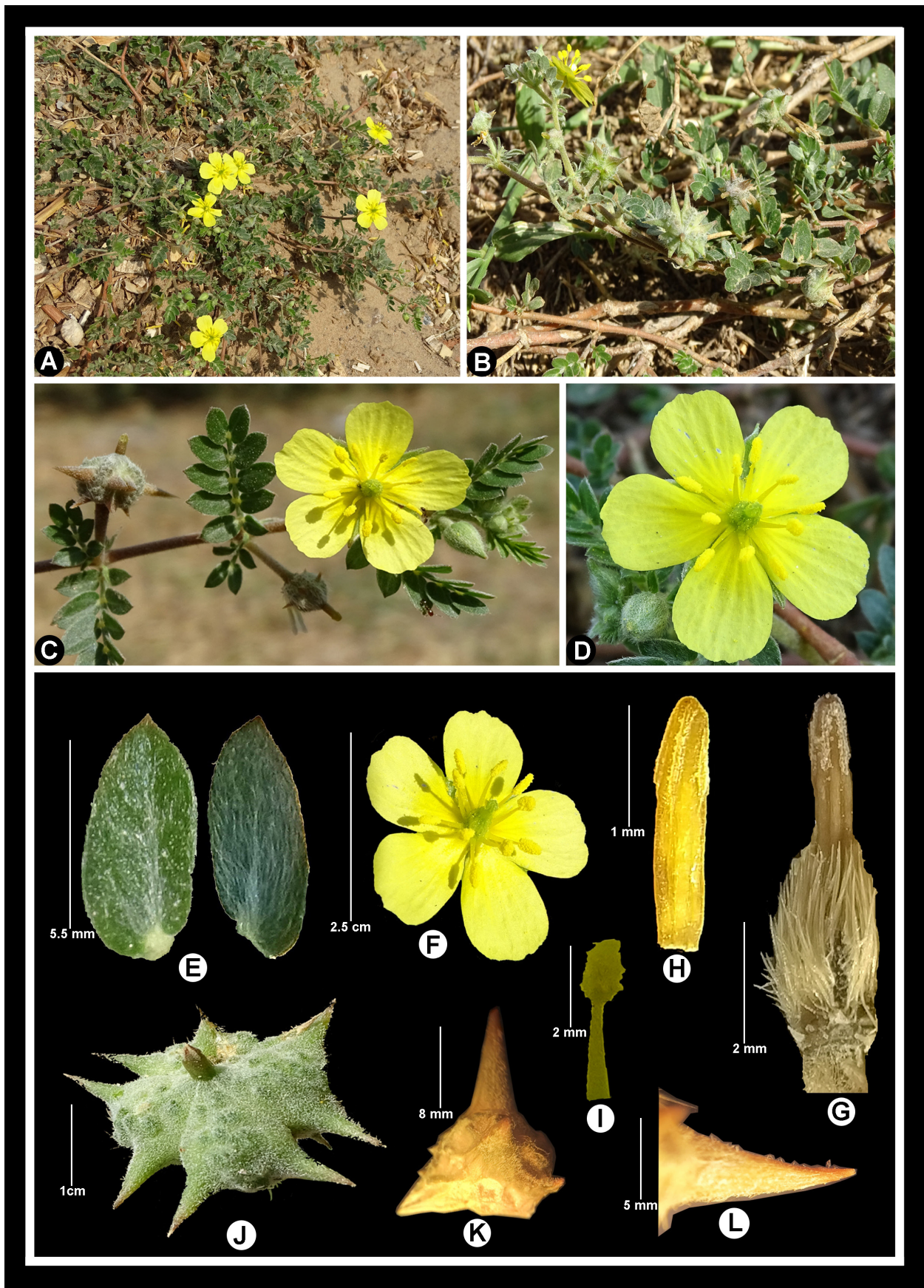


Fig. 2. *Tribulus cistoides* L.: A-B – Habit; C – Branch of plant; D – Close-up of Flower; E – Dorsal and ventral sides of leaf; F – Close-up of flower; G – Gynoecium with intrastaminal nectaries; H – Stigma; I – Stamen; J – Fruit; K-L – Microscopic image of mericarp and its spine.

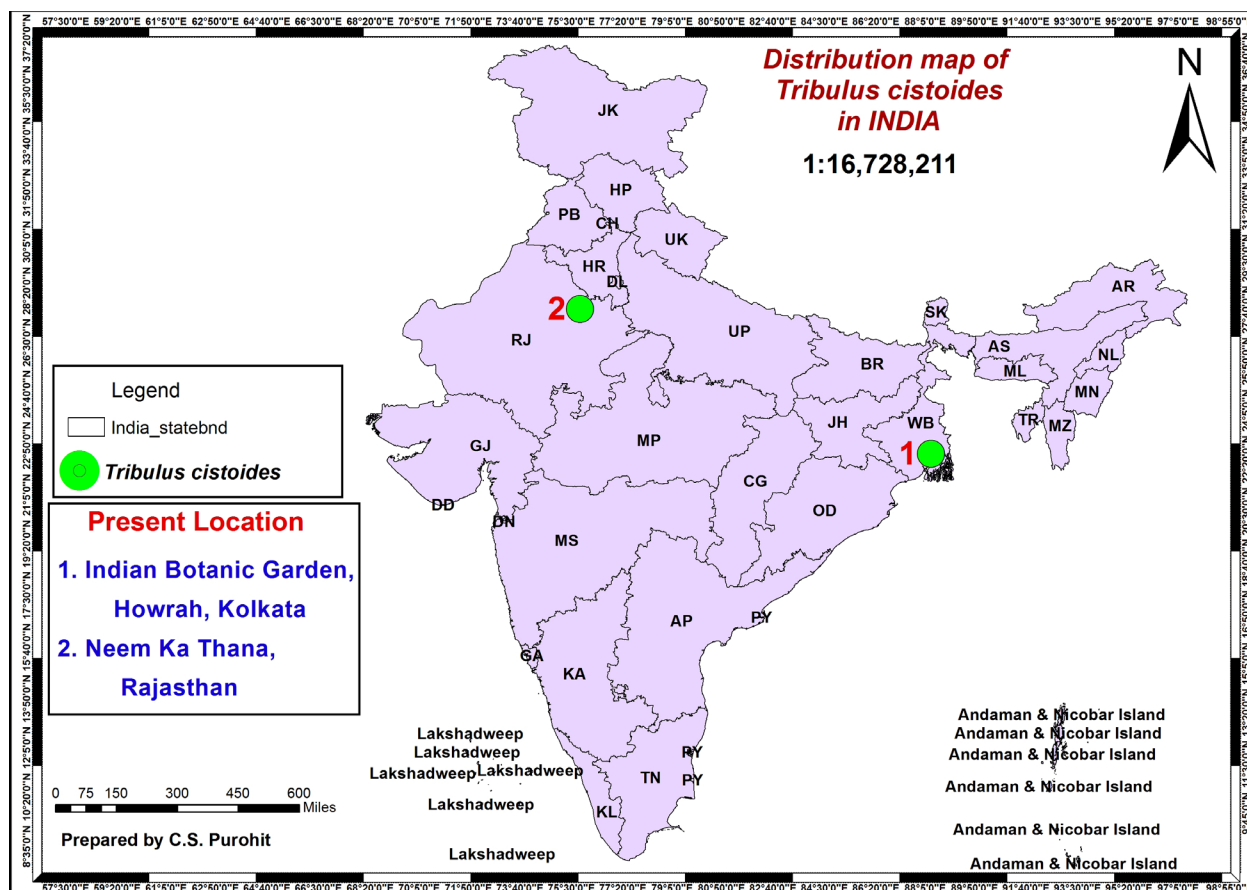


Fig. 3. Distribution of *Tribulus cistoides* L. in India.

often occurring in maritime habitats (Shu-Miaw et al., 1993). In the present study this species was found in sandy habitat in the Rajasthan State of India (Fig. 3).

Habitat. Inhabitant of semi-mobile sand dunes, sandy to stony desert associated with species like *Rhynchosia capitata* (Heyne ex Roth) DC. (the collection number 38209), *Launaea nudicaulis* (L.) Hook. f. (No. 38210), *Aerva javanica* (Burm. f.) Juss. ex Schult. var. *bovei* Webb. (No. 38212), *Aristida funiculata* Trin. et Rupr. (No. 38213), *Perotis indica* (L.) Kuntze (No. 38214), *Withania somnifera* (L.) Dunal (No. 38215), *Heliotropium subulatum* (Hochst. ex DC.) Vatke (No. 38216), *Digera muricata* Mart. (No. 38217), *Brachia riareptans* (L.) Gardner et Hubbard (No. 38218), *Alternanthera pungens* Kunth (No. 38219), etc.

Note. *Tribulus cistoides* is closely related to *Tribulus terrestris* but can be distinguished by its large flowers, long style, and intra-staminal glands connate into a five-lobed urceolate ring (Schweikerdt, 1937; Porter, 1972), while in *Tribulus terrestris* possess small flower with shorter style and intra-staminal glands five, triangular and free. This taxon is also closely allied to *Tribulus rajasthanensis*

but differs in having comparatively large flowers and 2 long and 2 short spines, while in *Tribulus rajasthanensis* having comparatively small flower and 2 long and 20–30 divergent spines.

Schweikerdt (1937) reported two types of glands occur in *Tribulus*, i. e. extra-staminal glands and intra-staminal glands. These characters are specific to each species and also observed that intra-staminal glands are sometimes free and sometimes united into a 5-lobed ring. In *Tribulus cistoides*, presence of intra-staminal glands united with 5-lobed rings.

It was first reported in India by M. P. Edgeworth and J. D. Hooker (1874) from West Bengal and Western Peninsula, and the specimens are in-house in CAL and BSI herbaria (Fig. 4).

These collections are from plants grown in the Botanic Garden, Howrah, and probably introduced by W. Hamilton in 1799 from America (Hajra et al., 1997). After that, Nayar and Giri (1982) reported this taxon on the basis of the Flora of British India. In view of all facts, the authors revealed that this taxon is un-hitherto reported and rediscovered for India from Indian desert for the first time in wild habitat after the lapse of 150 years.



Fig. 4. Herbarium specimen of *Tribulus cistoides* L. collected from IBG, Kolkata (Courtesy: H.O.O. CNH, BSI & Dr. Avinash Bharti, CNH, BSI, Kolkata).

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