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OCCURRENCE OF *FISSIDENS* HEDW. IN RAJASTHAN[1]

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ABSTRACT

The genus *Fissidens* is wide-spread in India. However, there are no records of *Fissidens* from Rajasthan in earlier works (Montagne, 1842 ; Mitten, 1859 ; Griffith, 1849 ; Brotherus, 1808 ; Dixon, 1929, 1930 ; Potier de la Varde, 1928 ; Brühl, 1931). Four species of this genus have been collected by the present writer from various parts of Rajasthan. These are *F. involutus* spp. *curvato-involutus* (Dix.) Gangulee, *F. diversifolius* Mitt., *F. geminiflorus* Doz. et Molk. var. *nagasakinus* (Besch.) Iwats. and *F. sylvaticus* Griff. This is the first record of this genus from Rajasthan and *F. geminiflorus* var. *nagasakinus* is a new record for India. *F. involutus* spp. *curvato-involutus* (Dix.) Gangulee so far recorded from north-western Himalayas—Saharanpur and Bastar (M. P.) is also known from this State.

INTRODUCTON

The genus *Fissidens* Hedw. like *Bryum* Hedw. is widely distributed in tropical and subtropical regions of the world. It is represented all over India. However, there are no records of *Fissidens* from Rajasthan in earlier works (Montagne, 1842; Mitten, 1859; Griffith, 1949; Brotherus, 1898; Dixon, 1929, 1930; Potier de la Varde, 1928; Bruhl, 1931). The genus is represented by four species in Rajasthan, namely, *Fissidens involutus* ssp. *curvato-involutus* (Dix.) Gangulee, *F. diversifolius* Mitt., *F. geminiflorus* Doz. et Molk. var. *nagasakinus* (Besch.) Iwats. and *F. sylvaticus* Griff. This is the first record of this genus from Rajasthan and *F. geminiflorus* var. *nagasakinus* is a new record for India. Norkett conveyed to the author that he had also collected it from Pachmarhi in Madhya Pradesh (unpublished). The author collected these species from various parts of Rajasthan. The specimens have been deposited in the British Museum (Natural History), London and the Department of Botany, University of Udaipur, Udaipur.

Rajasthan is the second largest state in India with an area of 3,42,274 Sq. Kilometer and lies between latitude 23°3′ N and 30°12′ N and longitudes 69°31′ E and 78°17′ E. It forms the eastern extremity of the great desert area of the World extending from the West coast of Africa to the North-Western India. It is bordered by Pakistan in the West and North-West, Punjab and Haryana in the East and South-East and Gujarat in the South and South-West. The state is dominated by Aravalli ranges in the South-West (Gujarat) to the North-East (Delhi).

The climate of Rajasthan is one of great extremes with sudden changes in temperature, precipitation and wind. Conditions at one point, may vary widely

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from year to year and often are extremely unsatisfactory for vegetation. The extremes of climate tend to restrict the bryophytic flora. Hence, Rajasthan is not rich in bryophytic vegetation and only those species which have a wide range of tolerance can survive. As such, only a limited number of species are actually restricted to this State.

The sparse and meagre bryophytic vegetation of Rajasthan was least known and therefore the author undertook this study. He recorded (Bapna, 1969) 38 taxa of liverworts and 40 taxa of mosses.

The genus *Fissidens* Hedw. shows great variations. The genus usually forms mats with procumbent or projecting leafy branches. Leaves are distichous and complanate, basal half of leaf of paired lamellae clasping the stem, apical half single and oriented vertically being variously decurrent on backs of costa; costa percurrent or subpercurrent. Leaf cells are unistratose, often rounded or hexagonal.

Key to the species:

1.	Leaves with borderon vaginant lamina	*F. diversifolius*
1.	Leaves without border	2
2.	Leaf base usually rounded, small glandular excrescence in the axil of most leaves....	*F. sylvaticus*
2.	Leaf base not rounded, no glandular excrescence in the axil of leaves.....	3
3.	The base of dorsal lamina with an abrupt rounded portion, then a slight decurrence, tappering at base....	*F. involutus* spp. *curvato-involutus*
3.	Pronounced decurrence of the base of dorsal lamina.....	*F. geminiflorus* var. *nagasakinus*

Fissidens involutus ssp. *curvato-involutus* (Dix.) Gangulee.

Syn. *F. curvato-involutus* Dix. Not. R. Bot. Gard Edinburgh. 19:279, 1938.

(Fig. 1a-h)

Plants yellowish green, in tufts, unbranched, 10 mm long, leaves (dry) contorted (moist) spreading in 8-12 pairs, 1.5-1.8 mm long, 0 42 m wide, oblong lanceolate, broadly acute, finely emarginate, lamina vera extending a short distance up the dorsal lamina and 1/2-3/4 length, dorsal lamina scarcely tapered, base of the dorsal lamina first an abrupt rounded portion then a slight decurrence tapering at the base; costa well developed, flexuose, ending below the apex or more or less subpercurrent, pellucid; cells hexagonal to rounded, 7-11 μ wide, thin walled, mamillosely convex with basal cells hardly enlarged.

According to Dixon *F. curvato-involutus* Dix. differs from *F. involutus* wils. ex Mitt. (Musc. Ind. Or: 138, 1859) in having longer setae, curved capsule and a distinct apophysis. Recently Gangulee (1971) considers that these differences are not sufficient to warrant them as separate species. Therefore he considers *F. curvato-involutus* as a subspecies of *F. involutus*.

Plants grow on moist soil or rocks, occasionally associated with *Phaeocers laevis* subsp. *carolinianus* and *Asterella angusta* (at Mount Abu) and *Riccia* sp. *Plagiochasma* spp and *Cyathodium* sp. Locality: Ajmer, Alt. 525 m, 94; Banswara-Madar hills, alt. 550 m, 140; Chittorgarh fort near a stream, alt. 950 m, 120; Jaipur-Ramgarh, in hills on road side, alt. 650m, 86; Mount Abu-near municipal park, alt. 1180 m, 51; Udaipur-700 m.

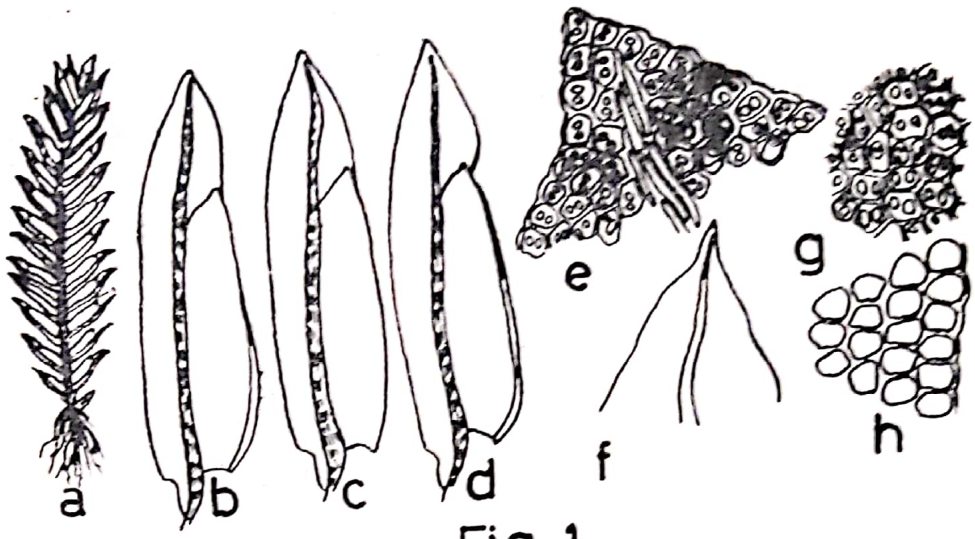

Fig. 1

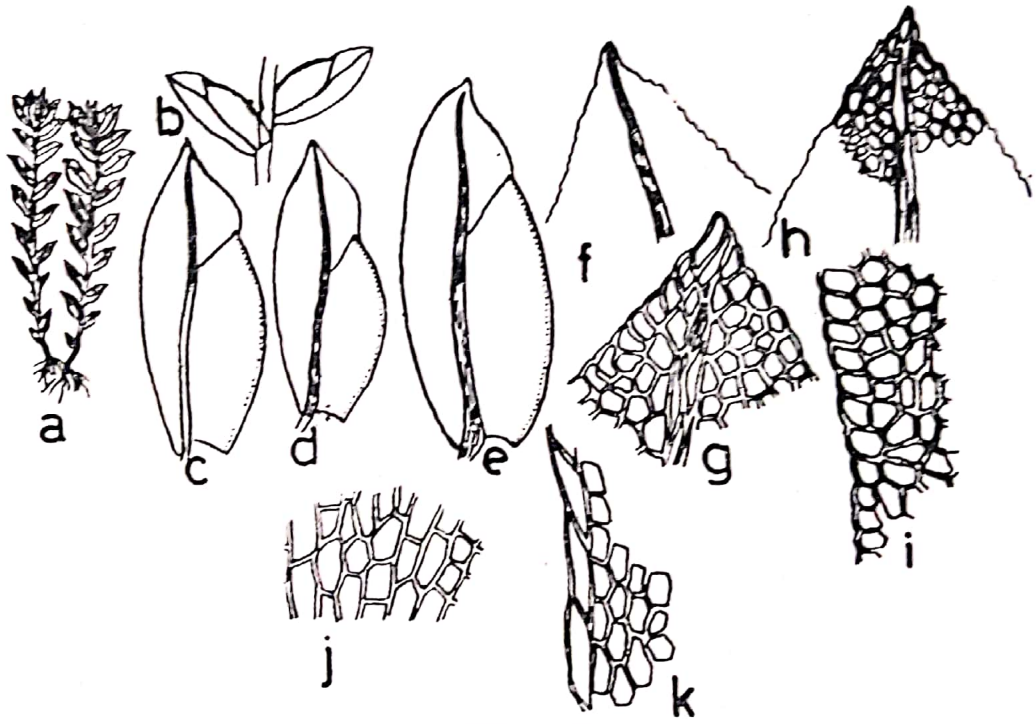

Fig. 2

Fig. 1 a
Fig. 1 b-d
Fig. 1 e, g, h, Fig. 2 g, h
Fig. 2, a
Fig. 2, b
Fig. 2, c-e
Fig. 1 f, Fig. 2 f, h

Fig. 1 : *Fissidens involutus curvato-involutus.* (a) plant, (b—d) leaves, (e & f) leaf apices, (g) cells from upper part of leaf, (h) cells from base of the leaf.

Fig. 2. : *Fissidens diversifolius.* (a) plant, (b) A portion of stem with leaves, (c-e) leaves, (f—h) leaf apices, (i) cells from upper part of leaf, (j) cells from base of the leaf near costa, (i) cells from base of the leaf margin (on laminavera).

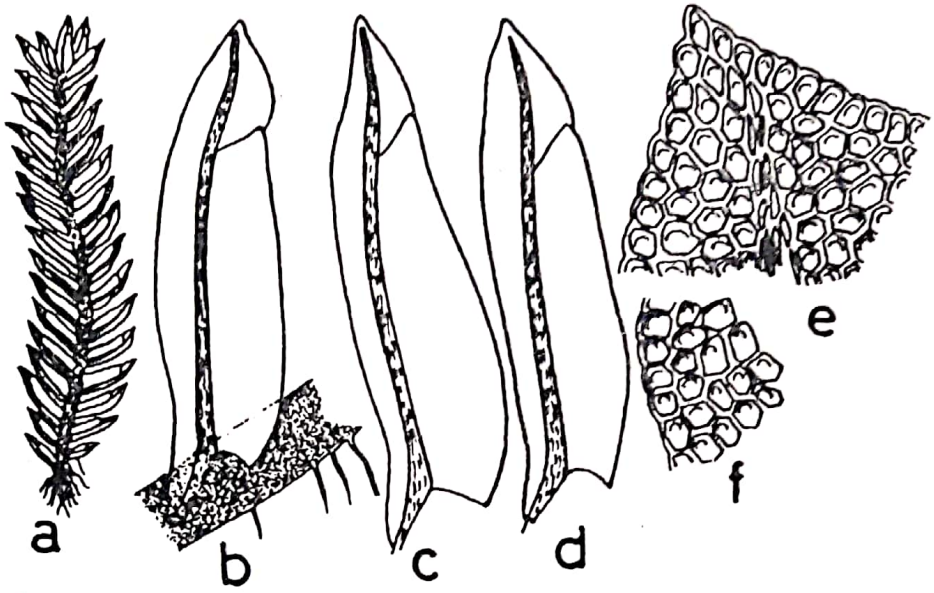

Fig. 3

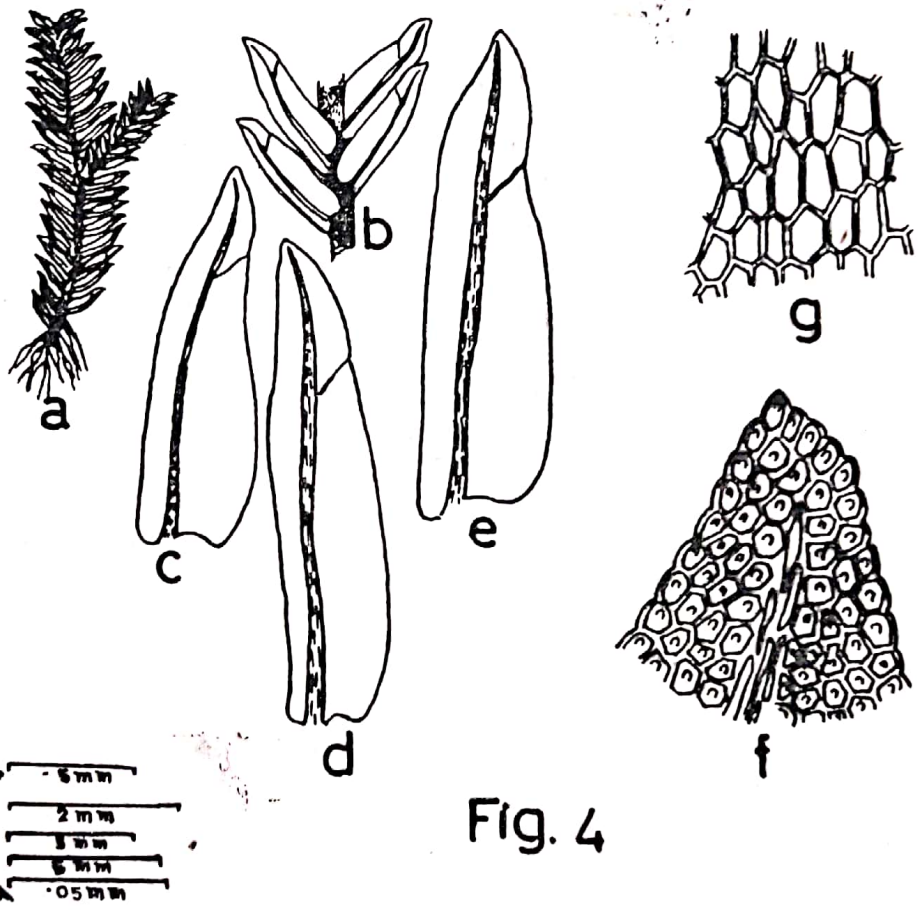

Fig. 4

Fig. 3. *Fissidens geminiflorus* var. *nagasakinus*. (a) plant, (b) portion of stem with a leaf (c & d) leaves, (e) leaf apex, (f) cells of the leaf.

Fig. 4. : *Fissidens sylvaticus* (a) plant, (b) stem portion with leaves (c—e) leaves, (f) leaf apex, (g) cells from base of the leaf.

Distribution: North-West Himalayas, Saharanpur, Rajasthan, Bastar (M. P.), Burma, Thailand, Vietnam.

Norkett is of the opinion that *Fissidens involutus* spp. *curvato-involutus* may be included in other species after further investigation (personal commnnication). It resembles *Fissidens geminiflorus* var. *nagasakinus* (Besch.) Iwats. The main difference between them is the ending of the base of the dorsal lamina.

Fissidens diversifolius Mitt., J. Linn. Soc. Bot. Suppl. 1:140, 1859.

Syn. *F. debilis* Wils. in Kew. J. Bot., 9: 294 (1857) nom. nud.
F. jeyporensis Dix. et Varde in Ann. Crypt. Exot., 1:38 (1928).
F. uii Broth. ex Ihs, in Classif. Moss. Jap. 77 (1932). *F. doii fid.* Takaki.
F. doii Sak. in Bot. Mag. Tokyo, 47: 736 (1933) *fid* Norkett.
F. mayebarae Sak. in Bot. Mag. Tokyo, 50:514 (1936). *F. doii fid.* Iwats.
F. lativaginatus Bartr. in Rev. Bryol. Lichen., 23:242 (1954) *fid.* Norkett.
F. diversifolioides Gangulee in Bull. Bot. Soc. Beng. 11:67 (1957).

(Fig. 2a-k)

Plants in tufts, light green with yellowish tinge. Stem upto 1.2 cm tall, simple, rarely branched, flexuose, delicate. Leaves in 8-18 pairs, not much altered (dry), spreading, 1 mm long, 0.53 mm wide distant below and crowded at apex, oblong-lanceolate, acute, more or less entire, margin slightly toothed above; lamina vera 2/3 to 3/4 leaf length with a border of hyaline cells, on lower leaves border not clear, dorsal lamina scarcely tapered; costa flexuouse, percurrent or ending below the apex or subpercurrent; upper cells hexagonal, thin walled, 7-12 μ wide, basal cells near costa larger, 8-10 μ × 15-20 μ, cells on the margin along dorsal lamina elongated, 6 μ × 33 μ, cells not distinctly papillose, oil bodies in cells often appear to be papillate.

Plants on moist rocks or soil near running water in a stream, associated with *Physcomitrium japonicum.* The species grow on ground or rocks which are flooded for a part of the year.

Locality: Mount Abu-Ada Lakda, a municipal post, alt. 1175 m, 5: in a stream on way to St. Mary's School, alt. 1200 m, 14; Kumarwara, alt. 1150 m, 22.
Distribution: Assam, Bihar, Bhutan, Orissa, Simla, Mussoorie, Nilgiri, South India, Western Ghats Rajasthan, Pakistan Ceylon, Burma, Malayasia and Japan.

Norkett , (personal communication) thinks that *Fissidens diversifolius* Mitt. involves more than one form or variety, as some species which were considered good species are to be considered varieties and the type of taxon must become *Fissidens diversifolius* Mitt. var. *diversifolius* (i. e. the original description of Mitten, 1859).

Fissidens geminiflorus Doz. *et* Molk. var. *nagasakinus* (Besch.) Iwats., Jour. Hattori Bot. Lab. 32: 272, (1969).

Syn. *Fissidens nagasakinus* Besch., J. de Bot. 12: 292, (1898).
F. irroratus Card, Beih, Bot. Centralbl. 19: 100, (1905).
F. takakii Sak., Bot. Mag. Tokyo, 47: 741 (1933).

(Fig. 3a-f)

Plants slender, bright to yellowish green, unbranched, 9-12 mm long. Leaves (dry) much curled, (moist) spreading, in 10-18 pairs, 2.2 mm long, oblong—lanceolate, acute, sometimes slightly apiculate; lamina vera 3/4 leaf length, sometimes extending a short dis-

tance up the dorsal lamina, dorsal lamina narrow, with a great decurrence of the base, margin minutely crenulate; costa stout, ending 2-3 cells below apex; cells more or less hexagonal, 7-15 μ in longest diameter, papillose, basal cells slightly thickened. Plants without capsules.

Plants growing on exposed or moist rocks or in crevices of rocks, sometimes associated with *Riccia billardieri*, *R. discolor*, and *Cyathodium barodae*.

Locality: Banswara—Madar hills, alt. 550 m, 143; Gorham Ghat near a stream, alt. 800 m, 106; Kota—Dhara hills, alt. 500 m, 147; Kumbhalgarh—hear the fort, alt, 1025 m, 124; Mount Abu-Kodra dam, alt. 1190 m, 52; Sirohi—Mandar about 36 miles from Sirohi (P. M Choudhary) 66; Udaipur—near Kewda-ki-nal, alt. 750 m.

Distribution: Rajasthan, Pachmarhi; Japan, New Guinea and Philippines.

F. geminiflorus var. *nagasakinus* is another example of the numerous Japanese species which are also found in India, often under other names. The species is recorded for the first time from India. Norkett conveyed to the author that he had also collected it from Pachmarhi (unpublished).

Fissidens sylvaticus Griff., Calcutta, J. Nat. Hist. 2: 507, (1842).

Syn. *F. zipplianus* Doz. & Molk. in Zoll. in Syst. Verzeich. 29 (1854) *fid.* Dixon.

F. circinalis Mitt. in Musci Ind. Or: 138 (1859) *fid* Norkett.

F. auricullaus C. Muell. in Linnaea, 37: 166 (1872) = *zippelianus* fid. Fleisch.

F. teraicola C. Muell. in Ibid: 164 fid. Norkett,

F. angustus Thwait & Mitt. in J. Linn. Soc. Bot., 13: 324 (1873) *fid.* Norkett.

F. terminiflorus Thwait. & Mitt. in Ibid: 322 = *zippelianus fid.* Fleisch.

F. corneus Hamp. in Jaeg. in Ber. S. Gall. Naturw. Ges., 1874-75: 123 (1876) = *zippelianus fid.* Fleisch.

F. zippelii Doz. & Molk. ex Kindb. in Ehum. Bryin. Exot.: 60, (1888) nom illeg. incl. sp. prior.

F. arbogastii Ren. & Card. in Ren. in Rev. de Bot., 9: 289, (1891) *fid* Dix.

F. cariaceifolius C. Muell. ex Dus. in K. Svensk Vet. Ak. Handl., 28: 6, (1895) = *zippelianus fid.* Fleisch.

F. subobscurus Par. in Ind. Bryol., 487 (1896) *fid.* Norkett.

F. lutescens Broth. in Rec. Bot. Surv. Ind., 1: 315 (1899) *fid.* Norkett.

F. elimbatus Broth. in Ibid: 316 = *zippelianus.*

F. circinnans Schimp. in Salm. in Ann. Bot., 13: 125, (1899) nom. invol. in synon.

F. camerunial C. Muell. in Gen. Musc. Fr.: 65, (1900) *fid.* Dix.

F. circinnatus Hamp. in C. Muell. in Ibid: 66 non. nud. *fid.* Norkett.

F. incurvescens Broth. in Schum. et Lauterb in Fl. Deutsch. Schutzgeb. Suedsee: 81, (1900) = *zippelianus fid.* Fleisch.

F. nanobryoides Broth. in Fleisch. in Musci Fl. Buitenz., 1: 23, (1904) = *zippelianus* nom, nud. in synon.

F. walkeri Broth. var. elimbatus (Broth.) Dix. in J. Ind. Bot., 2: 177 (1921).

F. angustiusculus Dix. & Varde in Arch. Bot., 1: 163, (1921) *fid.* Norkett.

(Fig. 4a-g)

Plants caespitose, simple or branched, delicate, bright green, 10-12 mm long. Leaves, in 12-20 pairs, 1.5—2 mm long, cripsed (dry), spreading (moist), lanceolate, acute, margin entire or slightly crenulate; lamina vera slightly more than 3/4 leaf length, dorsal lamina narrow with base usually rounded, rarely tapering at the base; in the axil of leaves a small glandular excrescence, consisting of a few enlarged cells, for water storage; costa yellow, flexuose, ending just below apex; upper cells hexagonal 8-10 μm wide, papillose; lower cells larger, 8-11 μm $\times$ 18-22.5 μm. No fruiting observed.

Plants grow in crevices of rocks, in a small stream in shady places or on loam in spray zone of water fall; associated with *Riccia* species and *Hyophila involuta.*

Locality: Alwar—Nandleshwar about 30 miles from the city, alt. 574 m, 17; Kota-Dhara, alt. 450 m, 152.

Distribution: Kumaon, Nainital, Sikkim, Assam, Palni hills, Rajasthan, Andamans; Ceylon, Burma, Pakistan, Cameroon, Congo, Madagascar, Thailand, Vietnam, Hong-Kong, Sumatra, Singapore, Java, Borneo, Celebes, New Guinea, Samoa, Japan, China, Formosa, Korea, Philippines, Central Africa, St. Helena Islands.

All these mosses are found in rainy season. During unfavourable period they remain under dried-up condition. It has been observed that most of the species of mosses in Rajasthan, fruit rarely if at all but propagate by vegetative means.

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