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Research Article

Taxonomic Study of some Mosses of Doodhpathri (Budgam) J&K, India.

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ABSTRACT

Doodhpathri is one of the most beautiful and unexplored place of the district Budgam of Kashmir Valley, surrounded by tall gymnosperms. The lush green grasses over the vast meadows and silver shinning streams running over the large stones further increase its beauty. Dense humid forests provide favourable conditions for the growth of mosses. The collection of mosses was done during the month of April, 2012. The collected taxa have been morphologically as well as anatomically studied and then identified. Total eight species of mosses, namely *Brachythecium kamounense* (Harv.) A. Jaeg,, *Brachythecium plumosum* (Hedw.) Schimp., *Brachythecium rutabulum* (Hedw.) Schimp., *Cratoneuron commutatum* (Hedw.) G. Roth., *Drepanocladus aduncus* (Hedw.) Warnst., *Haplocladium microphyllum* (Hedw.) Broth., *Hypnum cupressiforme* Hedw. and *Philonotis falcata* (Hook.) Mitt., have been studied and recorded from Doodhpathri (Budgam) for the first time.

Keywords: Budgam, bryophytes, mosses and taxonomy

INTRODUCTION

Doodhpathri is one of the most beautiful and unexplored places of the district Budgam of Kashmir Valley. Budgam is one of the districts of Kashmir, located in the northern part of India between the latitudes 34° 42' – 34° 50' N and 74° 24' –74° 54' E and has an area of 1291 km². In North, it is surrounded by Baramulla and Srinagar districts. District Pulwama is present in South and Poonch border occurs in South West. Pir- Panjal, and the Karewas as foothills, separate it from the Chenab valley and the Jammu region (Najar and Khan, 2011[1]; Lone and Romshoo, 2011[2]). The area has topography exhibiting altitudinal extremes of 1550 to 4700 m above mean sea level. Climate is temperate. The mean annual temperature is 20.2°C. Winter receives heavy snowfall and the average rainfall in the area is 669.1 mm (Rashid *et al.*, 2011)[3]. The soils in the area are generally of three types, viz., loamy soil, karewa soil and poorly developed mountain soil (Raza *et al.*, 1978)[4]. Humid forests provide favourable conditions for the growth of mosses.

Bryophytes are the second among major groups of green land plants after the flowering plants. They are the oldest land plants on earth and have three lineages, liverworts, hornworts and mosses. They occupy a unique position in the evolutionary status of cryptogams. About 60% of all bryophyte families have a world-wide distribution, which indicates a high phylogenetic age of this plant group (Frahm, 2012)[5]. Both corticolous as well as terricolous forms of mosses were found in the area. All the investigated species have medicinal and ecological importance. *Brachythecium kamounense* contains the neurotransmitter acetylcholine (ACh) that can be used in preparation of many medicines (Gupta *et al.*, 2001)[6]. *B. plumosum* has valuable medicinal importance (Awasthi *et al.*, 2012)[7]. *B. rutabulum* contains ferulic and possibly m- or p coumaric acids, which protect it from herbivory (Davidson *et al.*, 1989)[8]. *Cratoneuron commutatum* treats heart diseases and also have antibacterial activity (Bukvički *et al.*, 2012[9]; Ilhan *et al.*, 2006[10]). *Drepanocladus aduncus* is a good bioindicator and was used for the first national survey of atmospheric heavy metal deposition in Hungary (Otvos *et al.*, 2003)[11]. *Hypnum cupressiforme* is best bioindicator. It accumulates three times as much zinc, copper, and cadmium as do lichens or seed plants (Thomas, 1984)[12]. *Haplocladium microphyllum* treats cystitis, bronchitis, tonsillitis, and tympanitis. In China and Bolivia, native people use the paste of *Philonotis* to reduce the pain of burns (Singh, 2011)[13].

MATERIALS AND METHODS

The materials were collected during the month of April, 2012 from Doodhpathri, Budgam (J&K). The field data were recorded on the spot. The materials collected in polythene bags were air-dried and then kept in paper bags. To study the collected taxa, materials were soaked in boiling water for about 5-10 minutes to regain turgidity. The leaves were dissected under binocular microscope and mounted in Gum Chloral. Gum Chloral constitutes gum arabic, chloral hydrate, glycerine and distilled water with proportion of 40gms, 50gms, 20ml and 100 ml respectively. Later these slides were observed under microscope and studied. Studied materials were also photographed.

RESULTS AND DISCUSSION

Brachythecium kamounense (Harv.) A. Jaeg. (Figure 1)

Brachythecium is reported as one of the largest genera in the Northern Hemisphere (Ignatov *et al.*, 2008)[14]. *B. kamounense* was reported from the foothills of Himalaya. Earlier specimens were collected from Nepal and Kumaon (Long, 1995)[15].

Plant is robust growing in dense mats. It is glossy and yellow green in color and is dioicous, Main stem is creeping and secondary branches are erect and pinnate. Leaves are dense, imbricate, concave and plicate. Apex is acuminate and margin is denticulate. Leaf cells are linear-rhomboid and near the base they are shorter and wider. Base of leaf is formed of lax rectangular cells and they are visible at alar. Sporophytes are on main stem. Perichaetial leaves are erect with narrow and long acumen. Seta is erect. Long smooth. Capsules are horizontal, arcuate and ovate to oblong in shape. Operculum is conical.

Brachythecium plumosum (Hedw.) Schimp., (Figure 2)

Earlier it was reported from Japan and China (Ignatov and Koponen, 1996)[16]. It was also reported from Mussoorie and Mukteshwar in Western Himalaya (Awasthi *et al.*, 2012)[17].

Plant is normal to robust forming dense tufts. It is autoicous. Color of the plant varies from light green at top to brownish down below. Main stem is creeping, giving rise to pinnately erect branches. Leaves are dense, imbricate and erect with falcate tips. They are concave, ovate to lanceolate in shape. Margin is entire. Mid-rib covers about 2/3 of leaf length. Leaf cells are rhomboid at apex, rectangular at base and shorter at alar. Sporophytes are on main stem. Perichaetical leaves are erect squarrose. Seta is erect. Capsule are inclined horizontally and are arcuate. Operculum is short conical and calyptra is cucullate.

Brachythecium rutabulum (Hedw.) Schimp., (Figure 3)

B. rutabulum is cosmopolitan species. It is reported from Northern India, Peninsular India, Nepal, Bhutan, Sri Lanka, China, Japan, New Zealand, Papua New Guinea, Australia and America (Manju *et al.*, 2009)[18].

Plants of variable habit, robust, glossy and yellowish green in color. Plant is autoicous. Main stem is creeping, long, branches are pinnate. Leaf is concave, pilcate, cordate- lanceolate with narrow acumen and margin are denticulate to near base. Costa is covering half to two third of leaf length. Leaf cells are linear to rhomboidal at tip. Extreme base cells are lax, hexagonal and larger at alar. Sporophytes are on main branches. Perichaetial leaves are oblong, nerveless, with long and narrow acumen. Seta is erect and long. Capsule are oblong and arcuate. Operculum is short conic and peristome teeth are perfect hypnoid.

Cratoneuron commutatum (Hedw.) G. Roth., (Figure 4)

It is distributed in Europe, W. Asia, S.E Asia, N. Africa, N. America and Greenland (Ozdemr, 2001)[19].

It is sturdy in habit and forms tufts. Color of the plant varies from deep green to orange-brown in color. Branching is irregularly. Leaves are dense, erectopatent, oval-lanceolate and with the tip falacate. Stem leaves are wider. Branch leaves tips are falcate or circinate and decurrent at base. Costa is very strong, usually ending only a few cells below tip. Leaf cells are linear rhomboid. Alar distinct, formed of pellucid cells. Sporophytes are on main stem. Perichaetial leaves are narrow. Seta is very long and erect. Capsule is horizontal and arcuate. Peristome is normal, basal membrane high, cilia short, in groups of three.

Drepanocladus aduncus (Hedw.) Warnst. (Figure 5)

It is reported from Europe and N. America (Hedenas, 1996)[20].

It is slender to very robust and hygrophilous. Plant is dioicious It is green to brown in color. Leaves are falcate. Costa is single reaching upper half of leaf. Leaf cells are long and linear. Alar cell are quite distinct. Capsule is inclined horizontally. Peristome is double, normal and hypnoid. Operculum is conical, beaked or apiculate.

Haplocladium microphyllum (Hedw.) Broth. (Figure 6)

It is widespread species distributed in North-eastern India, Peninsular India, Nepal, Bhutan, China, Tonkin, Korea, Japan, Taiwan, Siberia, Cuba,

Europe, Mexico, Canada and South America (Manju *et al.*, 2009)[21].

Plants are robust and in tufts. It is yellow -green above, darker to brown below. Main stem is trailing and branching pinnately. Secondary branches are short and not sparingly branched. Stem leaves are larger. Leaves are convcave, erectopatent and ovate. Margins are dentate, flat or irregularly recurved. Costa is strong, covering the long apiculus. Leaf cells are ovate. Basal cells more elongate with fewer papillae or smooth.

Hypnum cupressiforme Hedw. (Figure 7)

It is a cosmopolitan specie but it is mainly distributed in Laurasia (Frahm, 2009)[22].

It is robust, light green, glossy and procumbent plants. It is brown in color. Branches are pinnate. Paraphyllia are very few. Leaves are imbricate, concave ovate or oblong- lanceolate. Margin is smooth or faintly denticulate at tip. Costa is short. Leaf cells are linear, alar cells are well developed by a large number of quadrate to sub-quadrate cells. Sporophytes on main stems. Perichaetial leaves are erect. Seta is slender, erect, long. Capsule is subcylinderical. Operculum is conic and short. Peristome perfect hypnoid.

Philonotis falcata (Hook.) Mitt. (Figure 8)

Philonotis falcata (Hook.) Mitt. is an exclusively Asiatic taxon (Kopoen , 2012)[23].

It is robust and forms extensive mats and is yellow green, interwoven with tomenta below. Stem is a whorl of subfloral branches. Leaves are spirally arranged, erectopatnet, triangular-ovate from broad base. Leaves are falcate, acuminate and carinate. Margins are flats, sharply denticulate all along. Leaf cells are narrow, ovate hexagonal, wider and rectangular at base. All cells are mamillose at one or both ends. Perichaetial leaves are more rectangular but not much differentiated. Seta apical, erect or slightly sinuose, red to brownish. Capsule is horizantal to pendulous, ovoid, brownish. Operculum is phanoconvex.

TABLE 1
LIST OF THE STUDIED TAXA ALONG WITH RELATED DATA

Name of The Taxon	Substratum	Herbarium reference number (PAN)	Figure No
ORDER:HYPNALES **FAMILY: BRACHYTHECIACEAE** *Brachythecium kamounense* (Harv.) A. Jaeg. *Brachythecium plumosum* (Hedw.) Schimp., *Brachythecium rutabulum* (Hedw.) Schimp.,	Soil Soil Soil	6103a 6104 a 6105a	1 2 3
FAMILY:HYPNACEAE *Cratoneuron commutatum* (Hedw.) G. Roth.,	Rock	6106a	4
FAMILY:AMBLYSTEGIACEAE *Drepanocladus aduncus* (Hedw.) Warnst.	Sandy bank of stream	6107a	5
FAMILY:LESKEACEAE *Haplocladium microphyllum* (Hedw.) Broth.	Wood logs	6108a	6
FAMILY:HYPNACEAE *Hypnum cupressiforme* Hedw.	Tree trunks	6109a	7
ORDER:BATRAMIALES **FAMILY:BATRAMIACEAE** *Philonotis falcata* (Hook.) Mitt.	Sandy bank of stream	6110a	8

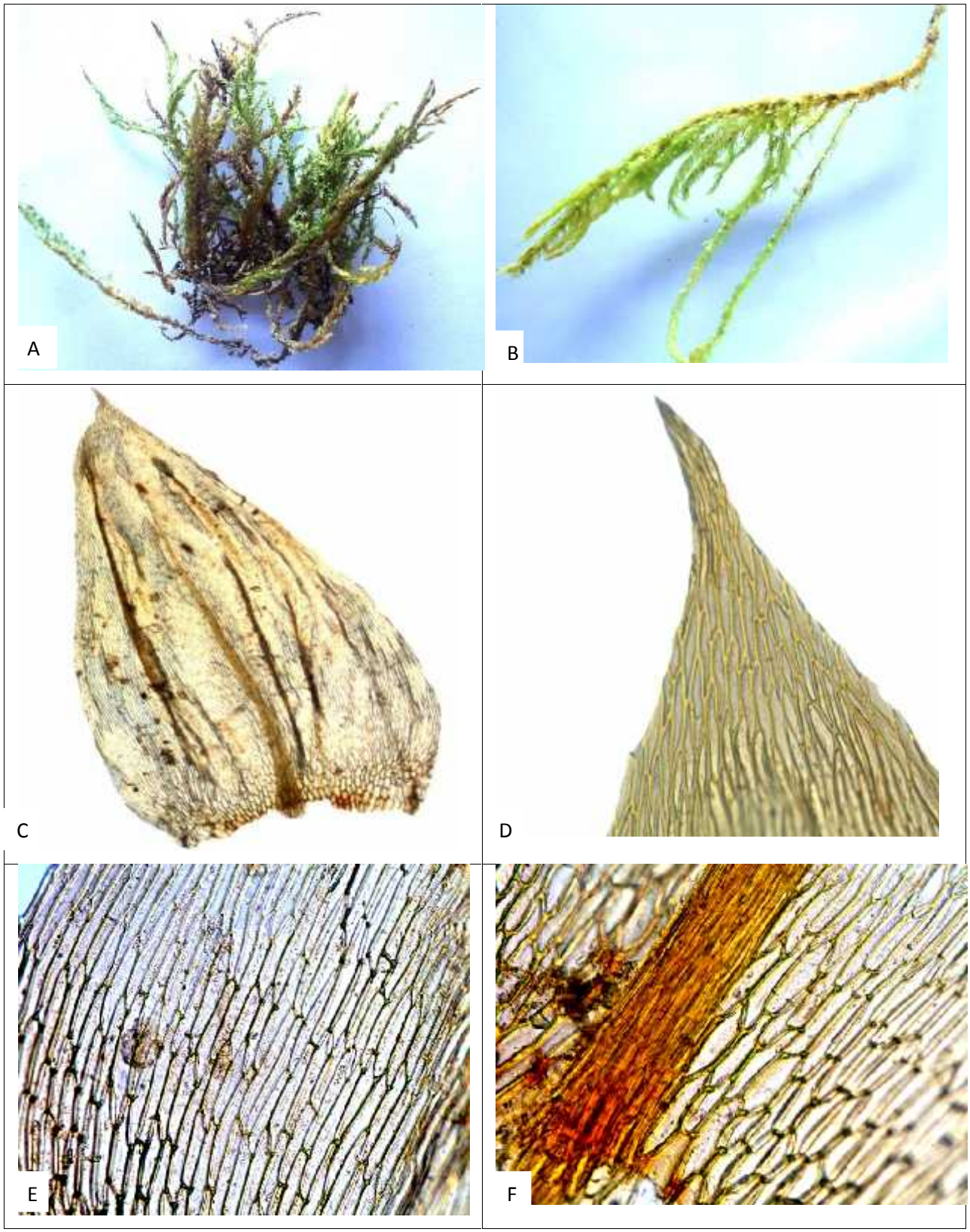

Figure 1
***Brachythecium kamounense* (Harv.) A. Jaeger: A Dry plant, B Wet plant, C Leaf, D Apical cells, E Middle cells and F Basal cells**

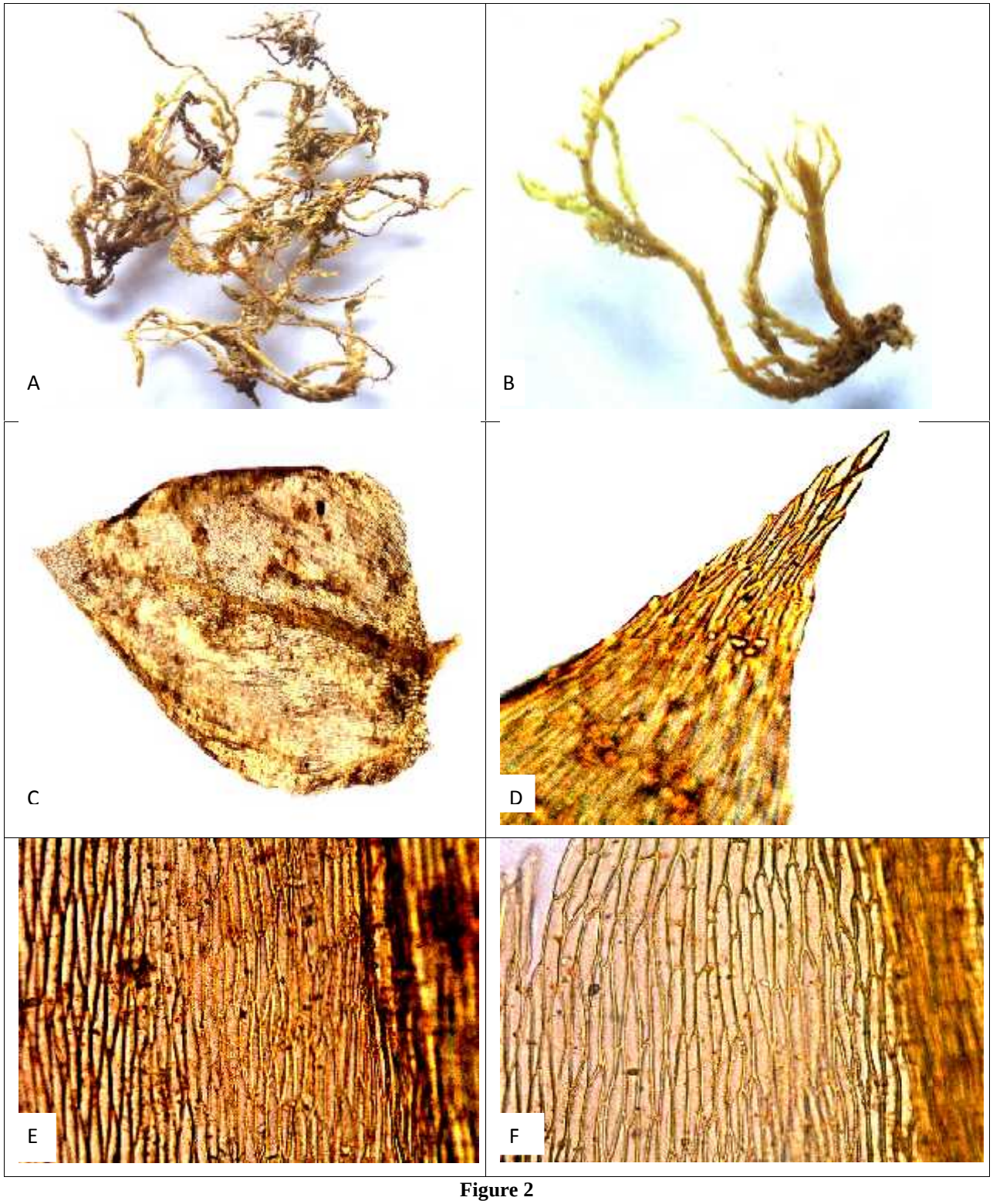

Figure 2
Brachythecium plumosum **(Hedw.) Schimp: A Dry plant, B Wet plant, C Leaf, D Apical cells, E Middle cells and F Basal cells**

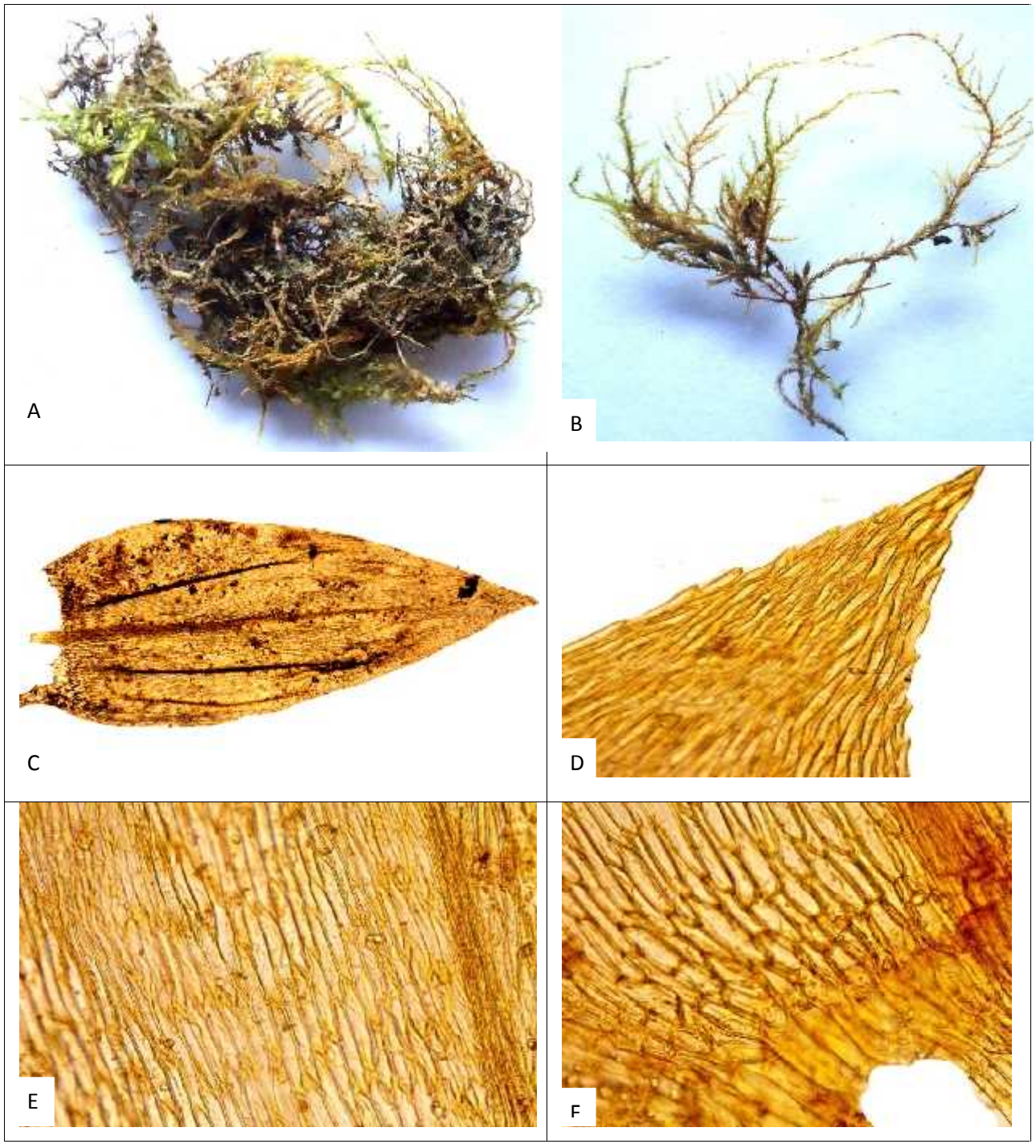

Figure 3
Brachythecium rutabulum **(Hedw.) Schimp., : A Dry plant, B Wet plant, C Leaf, D Apical cells, E Middle cells and F Basal cells**

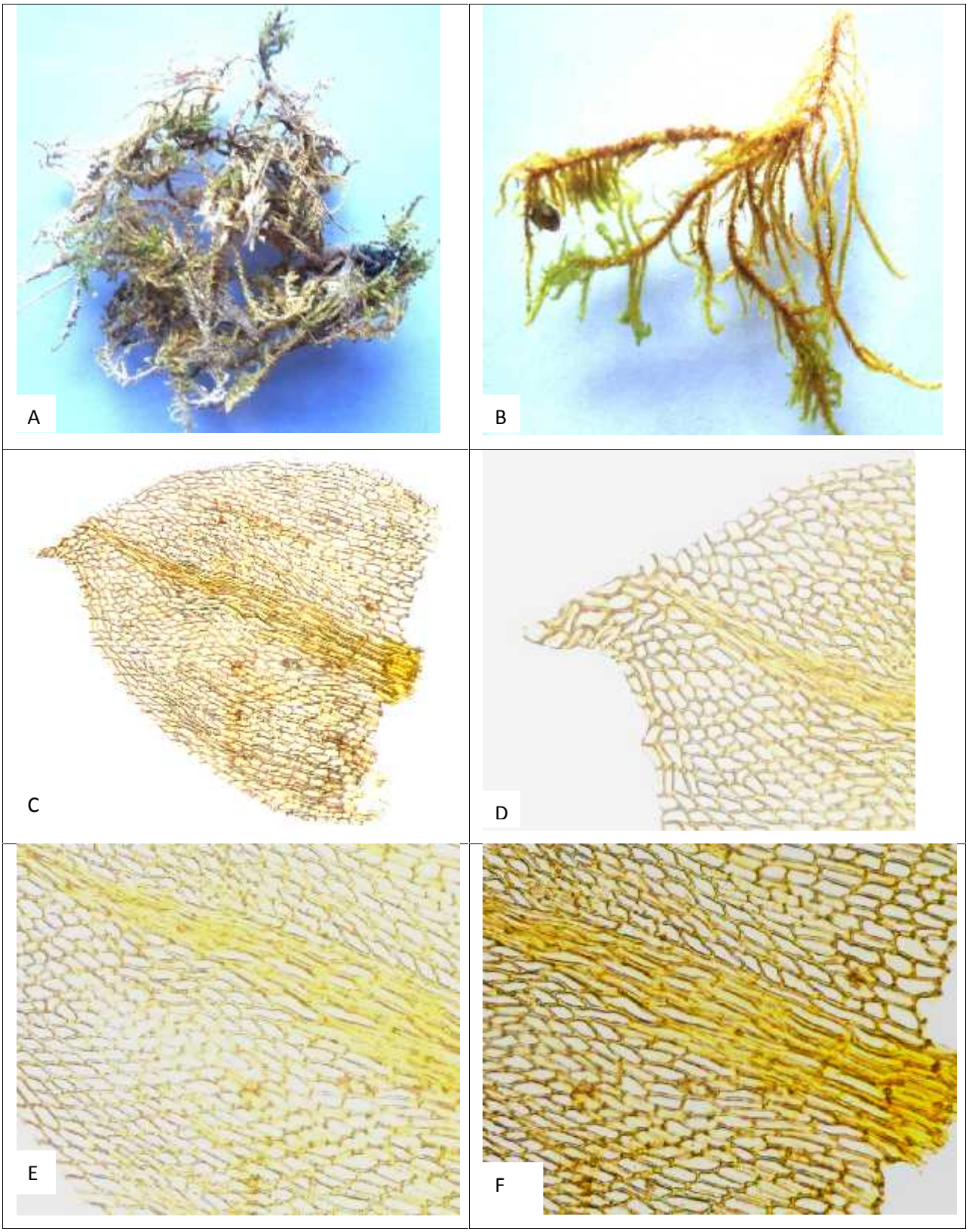

Figure 4
Cratoneuron commutatum **(Hedw.) G. Roth., : A Dry plant, B Wet plant, C Leaf, D Apical cells, E Middle cells and F Basal cells**

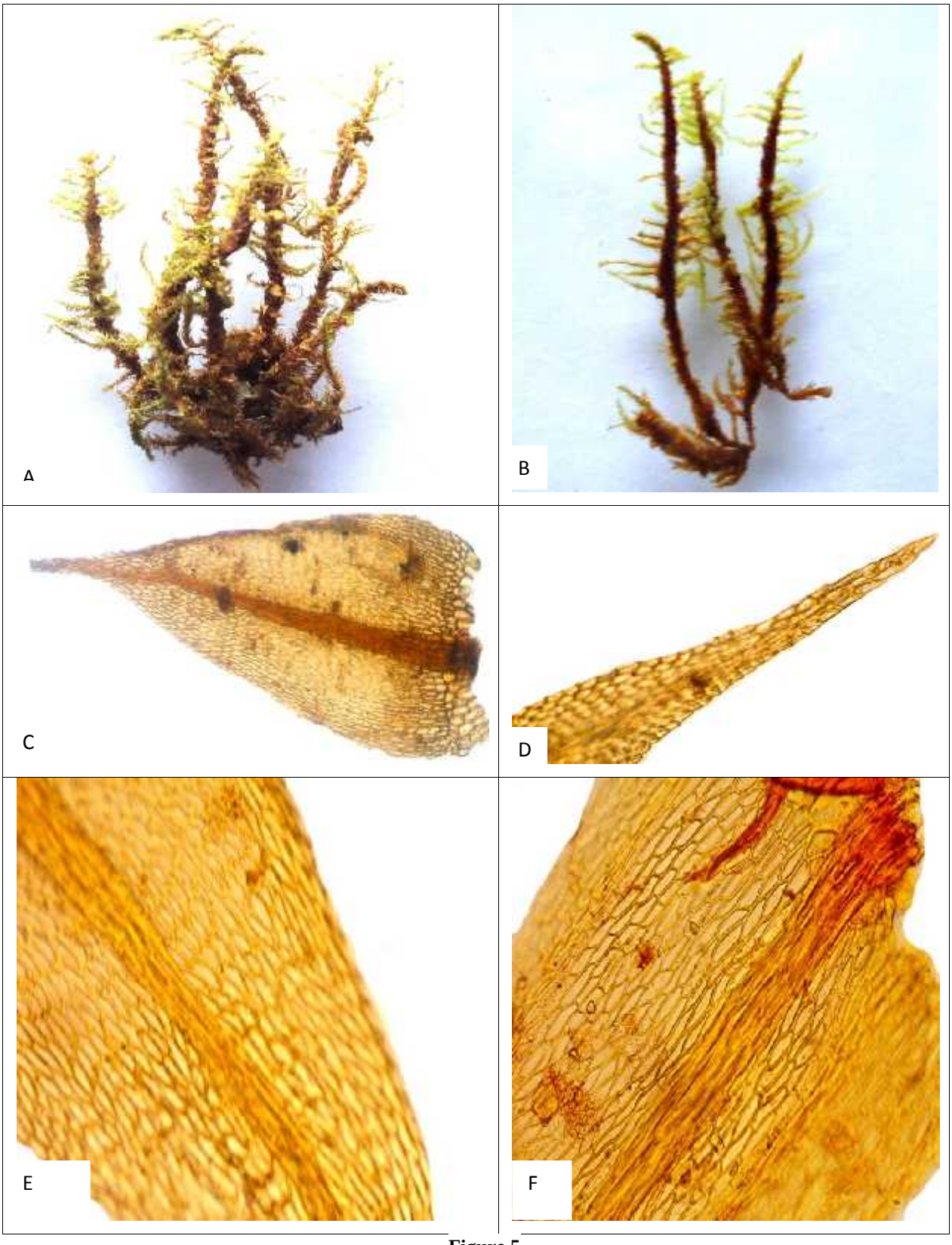

Figure 5
***Drepanocladus aduncus* (Hedw.) Warnst. : A Dry plant, B Wet plant, C Leaf, D Apical cells, E Middle cells and F Basal cells**

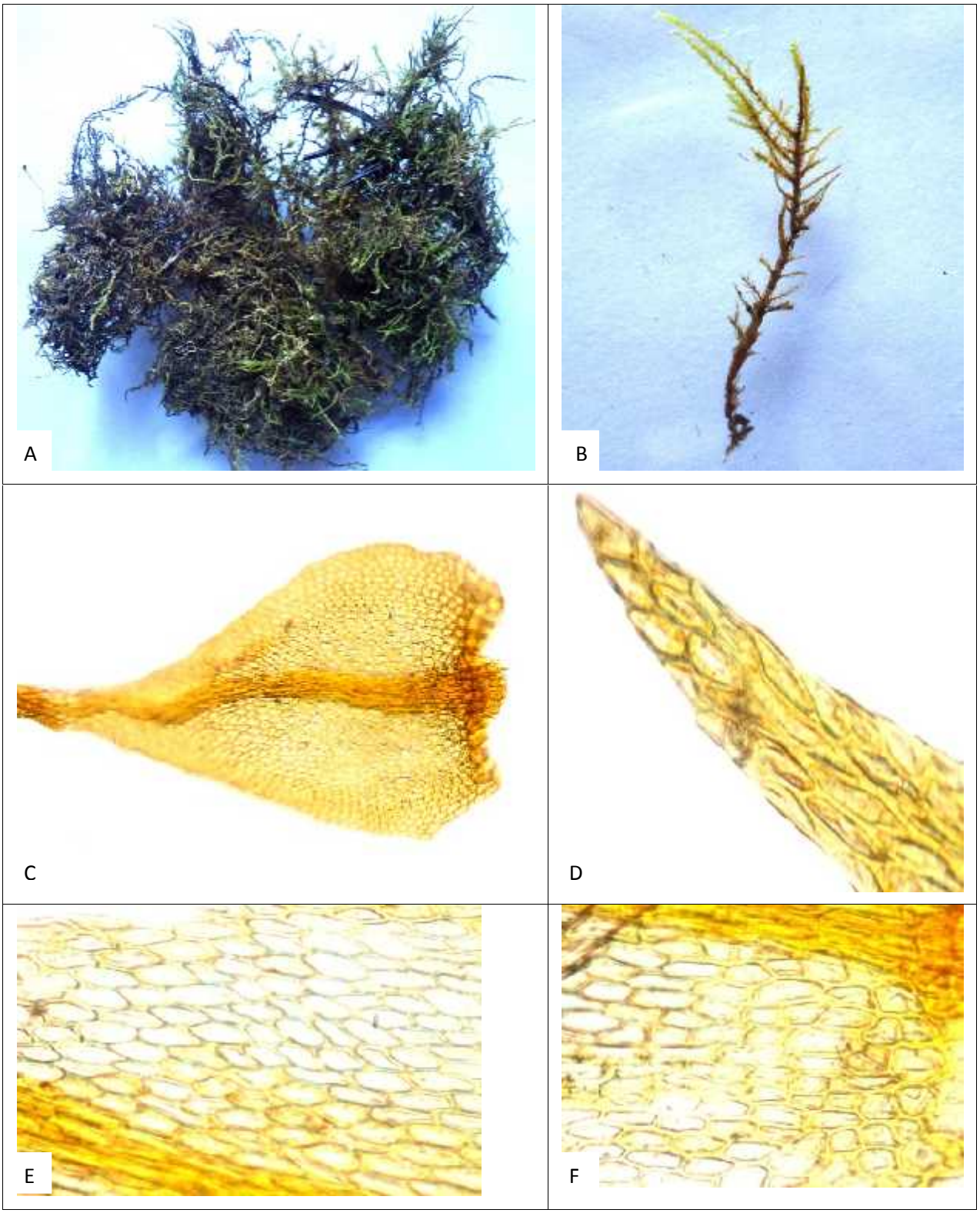

Figure 6
Haplocladium microphyllum **(Hedw.) Broth. : A Dry plant, B Wet plant, C Leaf, D Apical cells, E Middle cells and F Basal cells**

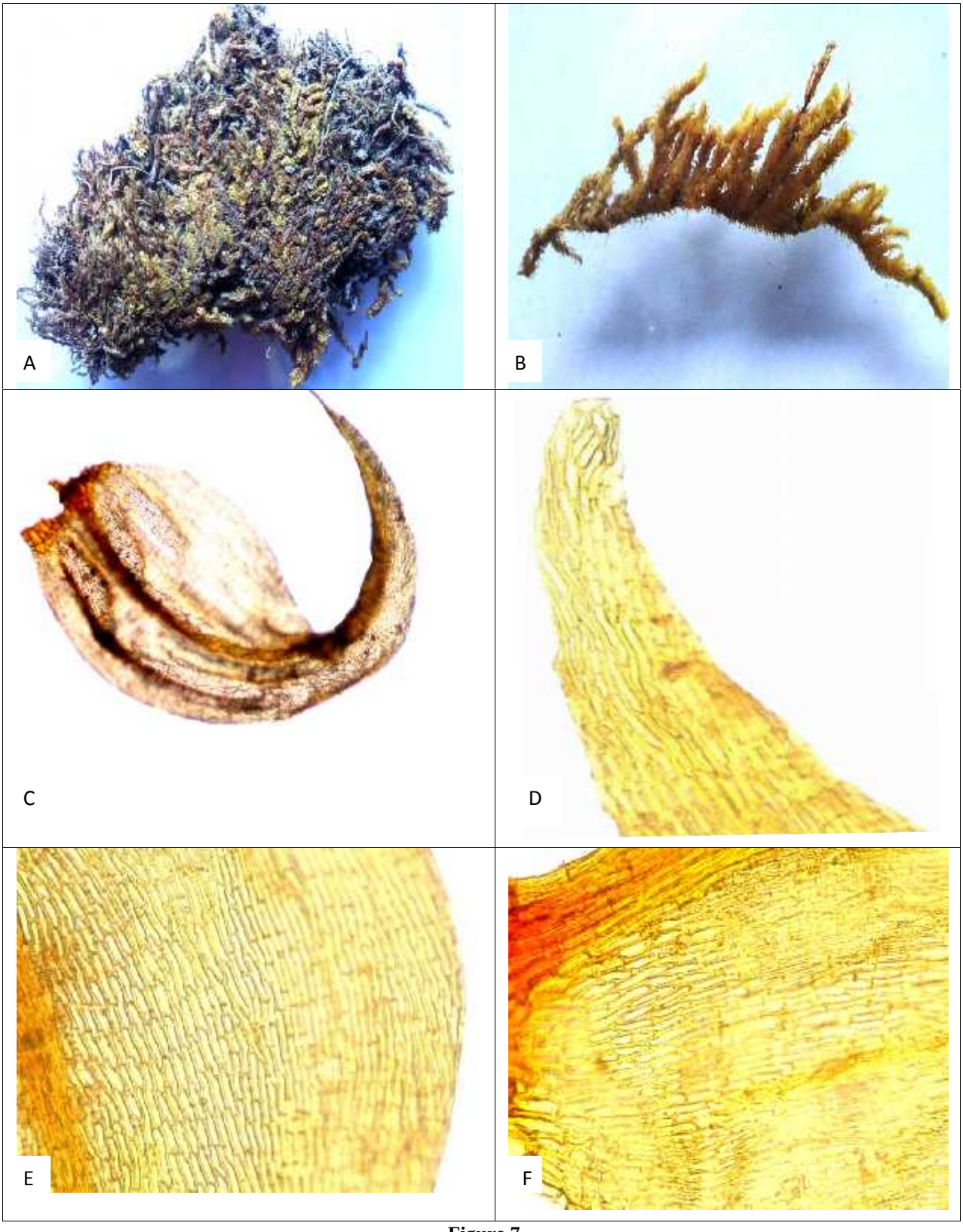

Figure 7
***Hypnum cupressiforme* Hedw. : A Dry plant, B Wet plant, C Leaf, D Apical cells, E Middle cells and F Basal cells**

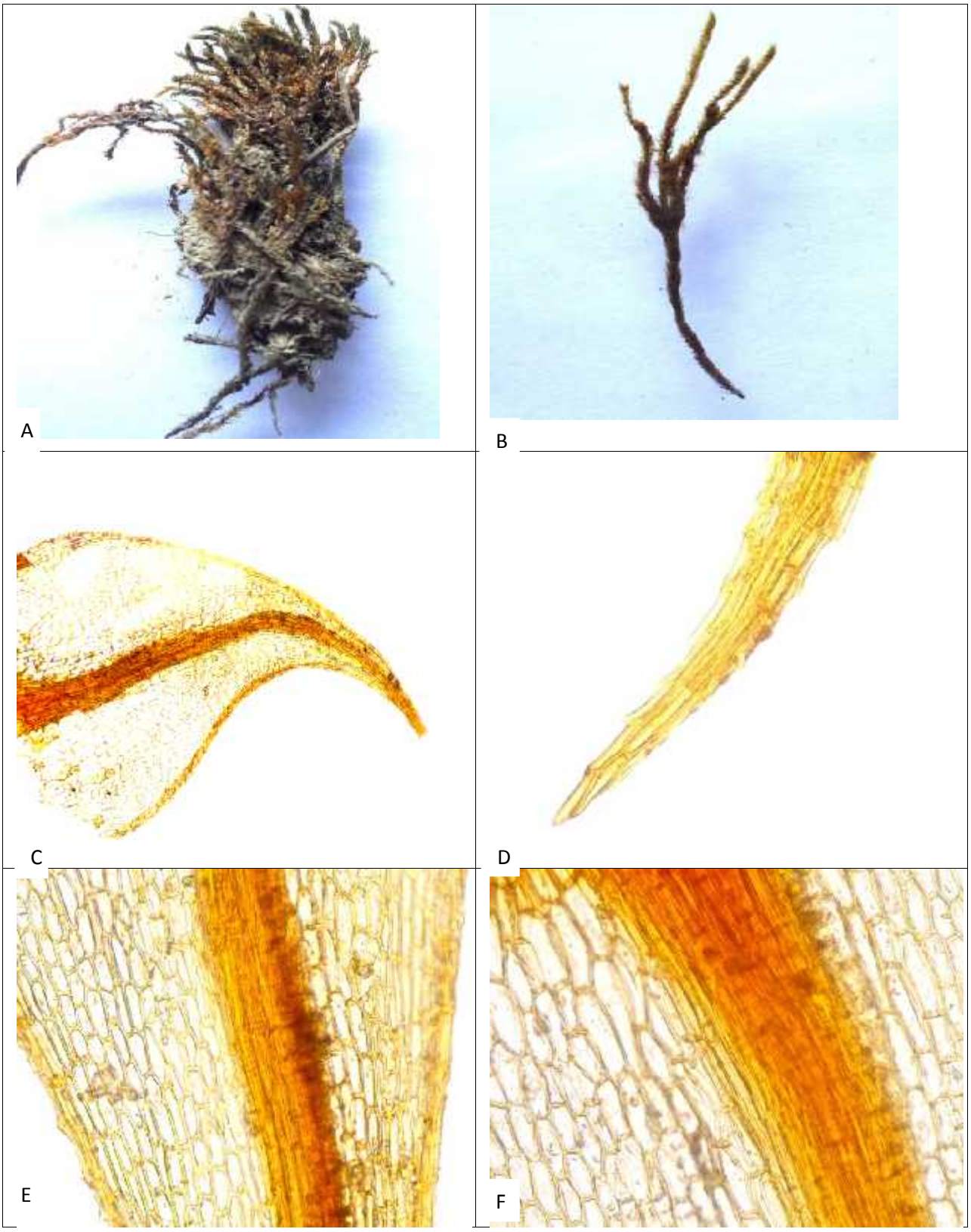

Figure 8
***Philonotis falcata* (Hook.) Mitt., : A Dry plant, B Wet plant, C Leaf, D Apical cells, E Middle cells and F Basal cells**

Although Doodhpathri is rich in bryoflora. The mosses investigated in the present study were unexplored earlier. This is the first attempt of their exploration from the area. Total eight species namely have been reported. The investigated species belongs to six families and six genera as described in Table 1.

CONCLUSION

Total eight species of mosses, namely Brachythecium *kamounense* (Harv.) A. Jaeg., *B. plumosum* (Hedw.) Schimp., *B. rutabulum* (Hedw.) Schimp., *Cratoneuron commutatum* (Hedw.) G. Roth., *Drepanocladus aduncus* (Hedw.) Warnst., *Haplocladium microphyllum* (Hedw.) Both *Hypnum cupressiforme* Hedw. and *Philonotis falcata* (Hook.) Mitt., have been studied and recorded from Doodhpathri (Budgam) for the first time. As there has been very little research on the mosses from this area so the possibilities and potential of use of the identified mosses for pharmaceutical and other purposes remain unexplored. Researchers of other related sciences and parallel domains may also find something interesting by studying these mosses further. This paper opens fresh avenues for future research on the identified mosses of Doodhpathri.

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