FISSIDENS LUISIERII P. VARDE (FISSIDENTACEAE, MUSCI),
A NEGLECTED SPECIES FROM MACARONESIA

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ABSTRACT. Fissidens luisieri was described by Potier de la Varde in 1955 from the Azores. But no study of this species has been made since the original description. This species is compared and contrasted with F. adianthoides Hedw., the Asiatic F. nobilis Griff., F. polyphyllus Wils. ex B. S. G., and F. serrulatus Brid. A description of F. luisieri and illustrations of F. luisieri, and F. serrulatus are provided.

INTRODUCTION

Fissidens luisieri, described by Potier de la Varde (1955) from the Azores (São Miguel), is based on material collected in 1940 by A. Luisier. In the original description Potier de la Varde referred this species to sect. Serridium (sensu Brotherus) and compared it with F. polyphyllus Wils. ex B. S. G. and F. adianthoides Hedw. Fissidens luisieri is listed in current Macaronesian checklists, such as by Eggers (1982), Corley et al. (1981) and Düll (1984, 1992), but no recent study of this species has been made.

Several years ago the first author made a number of collections of Fissidens on Madeira that appeared to be related to F. serrulatus Brid. but lacked the characteristic mammillose laminal cells. In the course of a revision of Fissidens from the Azores these specimens were seen to be identical with F. luisieri, a species known only from the Azores. Our examination of collections in European herbaria revealed that there is difficulty in recognizing F. luisieri. Some specimens had been annotated as “F. adianthoides?”, “similar to F. polyphyllus”, and “F. serrulatus with no mammillose cells”. Moreover, three specimens from the Canary Islands (Agua Garcia, 1833, BM, G, PC) were named F. denticulatus Brid., a nomen nudum.

The purpose of the present paper is to provide a modern description and illustrations of Fissidens luisieri, and to distinguish it from species with which it has been confused, F. adianthoides, F. polyphyllus, and F. serrulatus. Fissidens luisieri also has characteristics shared with the Asiatic F. nobilis. All of these species belong to section Serridium as defined by Iwatsuki and Inoue (1984), and have a similar type of peristome (Allen 1980, Bruggeman-Nannenga and Berendsen 1990) and similar costa (Bruggeman-Nannenga 1990).

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Fissidens luisieri P. de la Varde


Type: Archipel des Azores, Ile San Miguel, Tameyal (Tafsmujal), III 1940, leg. A. Luisier (PC).

Plants large, tufted, pale green to dark green, brownish red when old; stems simple, 2–9 cm long, 0.4–1 cm wide with leaves, erect, rhizoidous generally only at base, with central strand, axillary hyaline nodules not differentiated, cortical stem-cells thick-walled; leaves in 15–40 pairs, regularly and more or less densely arranged, erect-patent with stem when wet; middle and upper leaves lanceolate to linear-lanceolate, (4.5) 5–8 mm long, (0.5) 0.7–1.2 (1.3) mm wide; acute to obtusely acute, base of dorsal lamina rounded or decurrent; vaginant lamina about 1/2 the leaf length; costa stout, ending below apex; margin at leaf apex irregularly dentate to sparsely and faintly denticulate; margin bordered throughout by a darker to lighter colored band (yellow or orange brown), 4–6 (8) cells wide (Fig. 9, 10, and 11), at base of vaginant lamina a wide band of 8–20 (22) differentiated cells (Fig. 12); median cells of apical and dorsal laminae quadrate to hexagonal, thinner-walled compared with marginal cells, smooth (not mammillate), 10–16 (20) mm long; cells of vaginant lamina elongate to base and almost prosenchymatous, 2–6 as long as wide; lamina in cross-section 1 cell thick, in a regular arrangement (Fig. 10 and 11), rectangular to quadrangular.

 Dioicus; male inflorescences bud-like in axils of median leaves (usually 4–5 to 20 per plant), with small perigonal leaves and few paraphyses; antheridia 20–30 per perigonium; female inflorescences terminal, on main stems and on short lateral branches, with narrow perichaetial leaves; innovations of small female inflorescences often below the terminal inflorescence; setae terminal (1–2 per perichaetium) or appearing lateral, 0.8–1.5 (1.8) mm long, brown to orange brown, smooth; capsules inclined and asymmetrical, usually constricted below the mouth; 0.8–1.2 mm large to 1.5–2.3 mm long; exothecial cells quadrate to hexagonal, 20–30×25–40 (50) μm (Fig. 20 & 21); annulus present with 2 rows of cells (Fig. 17); opercula very long rostrate, 1.3–1.7 mm long; capsule perimeter with 115–140 cells; peristome teeth red or brick-red, erect when wet, 500–650 μm long, 100–130 μm wide at base, with smooth, thickened articulations, with papillae linearly arranged in lower half of lamellae and nodose filaments (Fig. 66 and 67); spores 12–16 (18) μm in diameter, nearly smooth (Fig. 68); calyptra campanulate, smooth, 1.5–2.0 mm long.

**DISCUSSION**

The features distinguishing *F. luisieri*, *F. nobilis*, and *F. serrulatus* are listed in Table 1.

1. Distinctions between *Fissidens luisierii* and *F. serrulatus*

The smooth, less obscure laminal cells of *F. luisierii* are the primary difference from *F. serrulatus* in which the laminal cells are highly mammilllose [holotype B; isotype BM, PC; Fig. 56, 57–61 & 63]. Further, in *F. luisierii* the leaf border is more distinctly differentiated. The leaf border of *F. luisierii* is translucent, yellow to orange or brown in older leaves, and consists, in the upper half of the leaf of 3–6 (8) rows of larger cells that are more or less prosenchymatous. In the base of the leaves this band consists of about 13 rows of prosenchymatous cells that are quite evident in cross-section (Figs. 9–12, 27–29 and 39). On the other hand, the leaf border in *F. serrulatus* is rarely coloured, and consists of 3–5 rows of short rhomboidal cells that are less evident in cross-sections (Figs. 45–47, 59–61).

These two species also differ in cross-sections of their leaves. In *F. luisierii*, the cells in the median part of the leaf are more or less regularly quadrate, smooth or with slightly convexly thickened walls (Fig. 10–11, 27–29, 39, 64, & 65). In *F. serrulatus*, the laminal cells are more or less polygonal and irregularly arranged, with high mammillae often more evident on one side of the leaf (Figs. 46, 47, 58, 59, 70, 72 and 73). Laminal cells of *F. luisierii* are generally larger [(8) 10–16 (20) μm] than of *F. serrulatus* [(6) 8–14 (16) μm].

There is considerable variation in the marginal denticulations of the apical and dorsal laminae in all specimens studied. In some specimens, including the type of *F. luisierii*, the denticulation is reduced and irregular (Fig. 36), while in other specimens, e.g., those of *F. denticulatus* Brid., nom. nud. (Fig. 24) the leaf apex is conspicuously dentate. Specimens with weak dentations at the leaf apex (as seen in the type of *F. luisierii*) are identical to the Madeiran plants known under the name *F. serrulatus* fo. *subintegrifolius* P. Varde.

We confirmed that *F. serrulatus* from Canary Islands (Tenerife), is not distinct from the material of the type locality of *F. langei* De Not. [Holotype RO, Italy, Ad Cape Penaghi] a species included in the synonymy of *F. serrulatus*.

Bruggeman-Nannenga (1990) considered the number of exothelial cells in the circumference of the capsule to be an important characters in the taxonomy of *Fissidens*. The number of exothelial cells is larger in *F. luisierii* (115–140) than in *F. serrulatus* (80–100). (Table 1)

2. Distinctions between *Fissidens luisierii* and *F. nobilis*

Both the apical and vaginant laminae of *F. nobilis* are bordered throughout by a dark band of cells, 2–4 layers in thickness (Abramova & Abramov 1968; Iwatsuki & Suzuki 1982; Li 1985). In both *F. luisierii* and *F. serrulatus* this marginal band is just 1 cell thick. As seen in cross-sections, cells in the apical lamina of *F. nobilis* and *F. serrulatus* cells are

mammillose to highly mammillose, and often, in part, bistratose and irregularly arranged (Figs. 45–47, 58, 61; see Iwatsuki & Suzuki 1982; Abramova & Abramov 1968). On the other hand, the cells of the apical and vaginant laminae of *F. luisieri* are always unistratose and regularly arranged. The cells of the vaginant laminae of *F. nobilis* are always unistratose and mammillose on the outer surface, while those of *F. luisiei* are unistratose and smooth.

3. Distinctions between *F. luisieri* and *F. polyphyllus*

*Fissidens polyphyllus* is a species large for the genus and usually grows in or nearer to streams than does *F. luisieri*. Morphologically, *F. polyphyllus* is difficult to mistake for any other species of subgenus *Serridium*. Unlike *F. luisieri*, there is no coloured marginal band of thickened marginal cells in *F. polyphyllus*. Leaves of *F. polyphyllus* are long and narrowly ligulate-lanceolate and the leaf apices have only a few obscure denticulations. The laminal cells are thickened, smooth, and decrease in size from costa to margin. By nature of its aquatic habitat and aspects of costa structure, *F. polyphyllus* is closer to *F. grandifrons* Brid. (Casares 1919).

4. Distinctions between *F. luisieri* and *F. adianthoides*

Leaf shape in *F. luisieri* is lanceolate to linear-lanceolate (Fig. 23 & 35), while that of *F. adianthoides* is broadly oblong to ovate. In addition to leaf shape, marginal border cells of these two species are quite different. Both species have a few rows of cells differentiated from other laminal cells: marginal cells of *F. luisieri* are distinctly prosenchnymatous while those of *F. adianthoides*, however, are thin walled. In cross-section of the apical lamina of *F. luisiei*, cells of the marginal border are much thicker-walled than laminal cells. The marginal cells of *F. adianthoides* are not thicker than laminal cells in cross-sections. Another difference between these two species is of spore size. Spores of *F. luisieri* are 12–16 μm (Fig. 68), while those of *F. adianthoides* are larger, 18–26 μm.

In keys to European *Fissidens*, specimens of *F. luisieri* often “key out” to *F. adianthoides*.

5. Distinctions between *Fissidens serrulatus* and *F. nobilis*

*Fissidens serrulatus* and *F. nobilis* are distinct from one another, based on the morphological features listed in Table 1. The most important distinguishing character, however...
<table>
<thead>
<tr>
<th></th>
<th><em>Fissidens luisieri</em></th>
<th><em>Fissidens serrulatus</em></th>
<th><em>Fissidens nobilis</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of leaf pairs</strong></td>
<td>(10) 15–36 (40)</td>
<td>(10) 15–25 (30)</td>
<td>18–46</td>
</tr>
<tr>
<td><strong>Leaf shape and length</strong></td>
<td>lanceolate to linear-lanceolate</td>
<td>ovate to lanceolate</td>
<td>lanceolate 1.0–1.6×4.5–8.7 mm</td>
</tr>
<tr>
<td></td>
<td>0.5–1.2×(4.5) 5.0–8.0 mm</td>
<td>0.8–1.3×4.0–6.5 mm</td>
<td>wide 4.5–8.7times</td>
</tr>
<tr>
<td></td>
<td>6–9 times as long as</td>
<td>4–6 times as long as</td>
<td>as long as wide</td>
</tr>
<tr>
<td><strong>Leaf apices</strong></td>
<td>irregularly dentate to sparsely</td>
<td>irregularly denticulate</td>
<td>irregularly dentate</td>
</tr>
<tr>
<td></td>
<td>and remotely denticulate</td>
<td>to coarsely dentate</td>
<td>to coarsely serrate</td>
</tr>
<tr>
<td><strong>Cells of apical laminae</strong></td>
<td>smooth or slightly bulging</td>
<td>highly mammillose</td>
<td>highly mammillose</td>
</tr>
<tr>
<td><strong>Cross-section of apical laminae</strong></td>
<td>1 cell thick</td>
<td>1 cell thick</td>
<td>usually 2 cells thick</td>
</tr>
<tr>
<td><strong>Cells of vaginant laminae</strong></td>
<td>smooth or slightly bulging</td>
<td>highly mammillose</td>
<td>highly mammillose</td>
</tr>
<tr>
<td><strong>Cells of leaf border</strong></td>
<td>smooth, glossy, generally colored, colored, 2 rows of smaller and 3–6 rows of usually long prosenchymatous cells</td>
<td>smooth, glossy, rarely colored, 1 row of smaller cell and 3–4 rows of usually short rhomboid cells</td>
<td>smooth, thick-walled, generally colored</td>
</tr>
<tr>
<td><strong>Cross-section of border</strong></td>
<td>1 cell thick</td>
<td>1 cell thick</td>
<td>2–4 cells thick</td>
</tr>
<tr>
<td>of apical lamina</td>
<td>entire, not serrulate</td>
<td>usually serrulate</td>
<td>almost entire to weakly serrulate</td>
</tr>
<tr>
<td><strong>Marginal border of vaginant lamina</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Shape or laminal cells</strong></td>
<td>Quadrangular to rectangular, regularly arranged</td>
<td>Quadrangular to polygonal (pentagonal), irregularly arranged</td>
<td></td>
</tr>
<tr>
<td><strong>in cross-sections</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Size of laminal cells (in μm)</strong></td>
<td>(8) 10–16 (20)</td>
<td>(6) 8–14 (16)</td>
<td>6–13</td>
</tr>
<tr>
<td><strong>Number of exothecial cells in capsule perimeter</strong></td>
<td>(115) 120–140</td>
<td>(80–100 (115)</td>
<td>120–131 from one specimen only</td>
</tr>
<tr>
<td><strong>Size of spores (in μm)</strong></td>
<td>12–16 (20)</td>
<td>10–14</td>
<td>15–19</td>
</tr>
</tbody>
</table>
is the thick (2–4 cell layers) margin of *F. nobilis*.

**GEOGRAPHICAL DISTRIBUTION**

*Fissidens luisierii* is restricted to Macaronesia (Madeira, the Canary Islands, and the Azores), while *F. serrulatus* has a broader distribution in the Mediterranean-Atlantic region (Macaronesia, Portugal, Italy, France, Corse, Spain, Greece, England, and northern Africa). *F. luisierii* seems to be more abundant than *F. serrulatus* in the Canary Islands, but both species are present in the same area (Agua Garcia). On the other hand, *F. serrulatus* is more widely distributed in the Azores than *F. luisierii*. We could not examine any material of *F. serrulatus* from Madeira Island.

*Fissidens polyphyllus* is found in Europe, Macaronesia, and disjunct in South Africa (Düll 1984), and has a strong oceanic affinity.

*Fissidens nobilis* is known from Asia and Oceania, and *F. adiantoides* has wide distribution range in the world.

**SPECIMENS STUDIED**

*Fissidens luisierii* P. Varde (*specimens with sporophytes*)

**AZORES. FAIAL:** Lombo, 1982 Sérgio 4376 (LISU); S. MIQUEL: Tamujal, 1940 Luisier (PC-Herb. P. Varde) (Holotype); Lagoa das Furnas, 1837 Persson (PC); Lameiro, 1898, Carreiro 645 (LISU 66503 ex.p.); Sete Cidades, 1980 Sérgio 2624 (LISU); Pico da Vara, 1937 Persson (BM). **TERCEIRA:** Furnas do Cabrito, 1982 Sérgio 4558 (LISU).

**CANARY. TENERIFE.** Agua Garcia, Pitard (PC-ex. Herb. Corbier); *Cumbre de Las Mercedes, 1855 H. Peraudière (BM); *Las Mercedes, Krause 21 (BM-Herb. Warnstorff); *Las Mercedes, 1928 Bequart (PC-Herb. Bizot); *Tenerife, d' rupes Agua Garcia, 1844 E. Bourgeau, Pl. Canarienses (BM) [Type of *F. denticulatus* Brid. (nom. Nud.)]; ibidem 38 (PC); *Agua Garcia, 1866 Husnot 160 (PC-Herb. P. Varde); *Anaga, 1855 H. Peraudière (BM); *Las Mercedes, 1908 Bryhn (Herb. Muñoz 2642); Las Yedras, 1987 Losada (Briotheca Hispanica 1109, BCB 931, NAU 4117, VABBrio 1813 and TFCbry 1754); *Monte de Agua Garcia y Cerro del Lomo, 1983 Losada et al. (BCB 21664 and TFCbry 2081); Las Mercedes, 1965 Dorta (BCB 13868); *Madre del Agua, Agua Garcia, 1971 Acuña (Briotheca Hispanica 339, NAU 250 and TFCbry 193); *Monte de Agua Garcia, 1971 Acuña (BCB 2159); Tacoronte, Monte de Agua Garcia y Cerro del Lomo, 1995 Ederra (NAU 6703); *El Piñaral, Anaga, 1995 Ederra (NAU 67036); *Las Mercedes, 1974 Rodriguez & Ron (TFCbry 249); Monte de las Mercedes, Llano de los Loros, 1981 Beltrán & Losada (TFCbry 842). **GOMERA.** Cumbre del Carbonero, 1954 J. Lid (PC-Herb. P. Varde). La Palma: *Barranco del Agua, 1978 Duell (LISU); Bosco de la Galga, 1978 Duell (LISU).

**MADEIRA.** *Chão de Louros, 1982 Sérgio & Nóbrega 3792 (LISU); Encumeada de S. Vicente, 1970 Koppe (LISU 162159); from Monte to Terreiro da Luta, 1951 Tavares (LISU 149113); from Queimadas to Caldeirão Verde, 1951 Tavares (LISU 149116); *Ribeiro Frio, Lamaceiros, 1992 Sérgio & Fontinha 7952, 7911, 7946 (LISU); *Faldas do Pico Jorge, Ribeira do Bonito, 1988 Sérgio & Nóbrega 6128, 6175 (LISU); Fanal de Baixo, 1992 Sérgio & Fontinha 8037 (LISU); *Fanal, Ribeiro Alto, 1994 Nóbrega (LISU); *Funduras, to Pico da Coroa, 1992 Sérgio & Fontinha 7958 (LISU); *Lamaceiros, 1886 Mandon (BM-Herb. Schimper); Levada do Furado, Cabeço do Pessegueiro, 1957 Romariz 744 (LISU 43576); Levada do Ribeiro Frio to Santo da Serra, 1951 Tavares (LISU 149115); Machico, Grotte do Cavalo, 1936 Barreto 73 (BM-Herb. Dixon); *Palheiro, Funchal, 1909 Armitage (BM-Herb. Dixon); Pico Grande, 1847 Love (BM); Poiso, 1937 Persson
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(PO- Herb. P. Varde); Poisso, pr. Casa do Poisso, 1970 Koppe (LISU 66448 ex.p.); Encumeada de S. Vicente, 1951 Tavares (LISU 149114); Rabacal, Levada do Risco, 1949 Romariz (LISU); Ribeira de S. Vicente, 1970 Koppe (LISU 66448 ex.p.); *Ribeiro Frio, Mandon 5 (BM- Herb. Beschelere and Herb. Schimper); *Ribeiro Frio, 1890 Menezes 97 (PC); Ribeiro Frio, 1970 Koppe (LISU 162160); Ribeiro Frio, 1979 Sérôgo 2366 (LISU); Ribeiro Frio, 1990 Thorn (Herb. Werner 5066); Ribeiro Frio, Levada do Furado, 1991 Fontinha (LISU); Levada do Ribeiro Frio to Balcões, 1990 Sauer et al. (SAAR and LISU); Vereda do Posto da Encumeada to Ribeira Grande de S. Vicente, 1982 Sérogo & Nóbrega 3819 (LISU); *Queimadas to Caldeirão Verde, 1995 Sérogo & Fontinha 9448, 9456 (LISU).

Fissidens serrulatus Brid. (Selected specimens) (*specimens with sporophytes)

CANTARI. GOMERA: La Gomera, 1978 Brugués (BCB 23382); La Zarza, 1978 Wildpret & Rodriguez (TFCbry 777 and TFCbry 778); Parque Nacional de Garajonay, Las Míneras, 1987 Losada & Beltrán (TFCbry 7125, 7137). LA PALMA: *La Palma, 1985 Brugués (BCB 23383); *El Canal and Los Tíles, 1990 Losada, González & Leon (TFCbry 7818); *El Canal and Los Tíles, 1989 Losada & González (TFCbry 7430). TENERIFE: Holotype, 1803 Bory (B, Herb Briedel 995); Bory (BM) Isotype; Bory de St Vincent (PC) Isotype; Sierra de Anaga, 1975 Redfearn & Crosby 30376 (PC-Herb. Bizot); Carboneras, 1975 Crosby 9562 (PC-Herb. Bizot); Agua Garcia y Cerro Lomo, 1995 Ederra (NAU 6702); Tacoronte, Monte de Aguá Garcia y Cerro del Lomo, 1995 Ederra (NAU 6702); Las Mercedes, 1971 Varo & Zafra (GDAC 9009); El Pijaral, Anaga, 1995 Ederra (NAU 6707 and NAU 6705).

CORSICA. La Piana, Calanehe, 1894 Fleisher (BM); Bonifas pro Calvi, 1901 Camus (PC).
GREAT BRITAIN. Devon, Hembrow Wood, M. Buckfastheigh, 1982 Gardiner (BM); Hartor Bridge, 1950 Norkett; Penzance, 1879 Curnow, Castle Horneck, Penzance, 1868 Curnow and 1886 Dixon & Curnow. (BM).
ITALY. Ad Cape Penaggi prope Arenzano, 1856 De Notaris (RO) Holotype of F. Langei De Not.;

Figs. 64-69. Scanning electron micrographs of Fissidens luissierii P. Varde. 64-65. Aspects of the foliar texture in median part of dorsal lamina. 66. Filament of peristome. 67. Outer surface of undivided part and bifurcation of a peristome tooth. 68. A spore and outer surface of peristome tooth. 69. Outer surface of the peristome tooth at the bifurcation.

Figs. 70-74. Scanning electron micrographs of Fissidens serrulatus Brid. 70, 72, 73. Aspects of the foliar texture in median part of dorsal lamina. 71. A spore and outer surface of a peristome tooth. 74. Filament of peristome [Fig. 64 from Madeira, Sauer et al. (LISU); 65-69. from Madeira, Sérogo 9448 (LISU); 70 and 73 from Monchique, Solms (BM); 71, 72 and 74 from Bussaco, Sérogo 6071 (LISU)]. Scale bar=10 μm.
Base della Alps Apuane, Toscana Sena, 1882 Bottini (PC); Monte Pisano ad Asciano, Toscana, 1887 Bottini (PC); Monte Pisano, 1903 Bottini (BM).

MAROCCHI. Gebel Kebui, 1934 Richards (PC).


TUNISIA. Ain Drahan, 1945 Call. Labbe 278 (PC-Herb. P. Varde). Type of F. serrulatus Brid. var. africanaus Besch.

FISSIDENS NOBILIS Griff. (Selected specimens)


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Corley, M. F. V., A. C. Crundwell, R. Düll, M. O. Hill & A. J. E. Smith (1981): Mosses of Europe and the Azores; an annotated list of species, with synonyms from recent literature. J. Bryol. 11:
609–689.