Tropical Bryology 16: 117-126, 1999

Key to Latin American species of *Bazzania* S. F. Gray

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Abstract: A new key to neotropical species of the genus *Bazzania*, based on the descriptions by Fulford (1946, 1963), is provided. A list of the treated species is added.

Introduction

The liverwort genus *Bazzania* is characterized by ventral flagelliform branches, dichotomous branching, incubous lateral leaves and the presence of underleaves. It is easily to recognize at the genus level but the species are often difficult to define because of the high variability of morphological characters (Fulford 1963, Spruce 1884-85). Variation may occur between stems of the same plant but is often extreme among plants of different areas and seems to depend mainly on different microclimatic conditions. In dry habitats, for example, plants are mostly smaller (Bernecker 1990, Kitagwa 1967) with thicker cell walls and larger underleaves compared to plants of the same species growing in wet conditions. As a consequence of the high variability, several species were described repeatedly as new in the past. Stephani (1908, 1924) for example, described about 115 species for the New World alone. Fulford (1946, 1959, 1963) made comprehensive studies of the Latin American species. She reduced many of the described taxa to synonymy and finally only 55 species remained. Although Fulford (1963) mentioned her difficulties of establishing limits of certain taxa, because of the high variability of its morphological characters, her species concept seems to be quiet good. The descriptions are very detailed with valuable figues useful to compare similar species. Unfortunately, the key provided by Fulford (1963) is very hard to use, because many subjective characters were used.

This paper presents a key based exclusively on the classification and descriptions of species according to Fulford (1946, 1963). Mostly objective characters, like data of measurements are used. Some parts of the key are similar to that offered by Fulford (1963), while others are quite different. Groups like the Bidentatae, Vittatae and Connatae could be treated easily, due to the small number of species. Most difficulties appeared doing the key of Appendiculatae and Grandistipulae because of the presence of several very similar taxa. Both groups are in need of revision including investigations about the variability of the vege-

tative characters and their dependency on microclimatic conditions.
With the new key species identification is more sucessfull and leads at least to the corresponding species whose description fits the best. Nevertheless species identification cannot be definite since much work on this genus is lacking. Specimens which cannot be determined might be an unknown variation, a depauperate form of a species or even a new species. But it also should be taken into consideration that only the 55 species described by Fulford (1963) are treated (Table 1) and that taxa described later are not included in this key. In any case, this new key may be helpful in becoming aquainted with *Bazzania* in Central and South America, and it may be a base for futher work in this field.

For the use of the key the following instructions should be followed. Because of the variability of characters, it is necessary to study several lateral leaves and underleaves from different stems of the same plant. They should be separated very carefully, because structures like auricles often remain on the stem and lead to incorrect judgement of the leaf structures. Measuring should be done as indicated in Figure 1. The size of the trigones is an important feature to separate species. Based on my own experience, the terms used in the key are related to objective measurements as indicated in Table 2. Measurements at the limit from one category to the other are critical and in this case it is recommended to follow both aternatives. The key should be used together with the publications by Fulford (1946, 1963) where all descriptions and figures of the species are given. It also facilitates the comparison of similar taxa.

Table 1: Species of the genus *Bazzania* treated in the new key

B. acanthostipa Spruce
B. acuminata (Lindenb. & Gottsche) Trevis.
B. affinis (Lindenb. & Gottsche) Trevis.
B. arcuata (Lindenb. & Gottsche) Trevis.
B. armatistipula (Steph.) Fulford
B. aurescens Spruce
B. bidens (Nees) Trevis.
B. boliviana (Steph.) Fulford
B. breuteliana (Lindenb. & Gottsche) Trevis.
B. caneleansis (Steph.) Fulford
B. chilensis (Steph.) Fulford
B. chimantensis Fulford
B. chimborazensis Spruce
B. crassidentata Fulford
B. cubensis (Gottsche) Pagán
B. cuneistipula (Gottsche & Lindenb.) Trevis.
B. denticulata (Lindenb. & Gottsche) Trevis.
B. diversicuspis Spruce
B. eggersiana (Steph.) Pagán
B. elongata Fulford
B. falcata (Lindenb.) Trevis.
B. fendleri (Steph.) Fulford
B. glaziovii (Gottsche) Fulford
B. gracilis (Hampe & Gottsche) Steph.
B. herminieri (Steph.) Pagán
B. heterostipa (Steph.) Fulford
B. hookeri (Lindenb.) Trevis.
B. jamaicensis (Lehm. & Lindenb.) Trevis.
B. latidens (Gottsche) Fulford
B. liebmanniana (Lindenb. & Gottsche) Trevis.
B. longa (Nees) Trevis.
B. longistipula (Lindenb.) Trevis.
B. macrostipula Fulford
B. nitida (F.Weber) Grolle
B. pallide-virens (Steph.) Fulford
B. peruviana (Nees) Trevis.
B. phyllobola Spruce
B. placophylla (Taylor) Grolle
B. pycnophylla (Taylor) Trevis.
B. quadricrenata (Gottsche) Trevis.
B. robusta Spruce
B. roraimensis (Steph.) Fulford
B. schlimiana (Gottsche) Fulford
B. schwaneckiana (Hampe & Gottsche) Trevis.
B. serrata Fulford
B. skottsbergii (Steph.) Fulford
B. spruceana Steph.
B. stolonifera (Sw.) Trevis.
B. sublonga Fulford
B. taleana (Gottsche) Fulford
B. tayloriana (Mitt.) Fulford
B. teretiuscula (Lindenb. & Gottsche) Trevis.
B. tricrenata (Wahlenb.) Trevis.
B. tricuspidata (Steph.) Fulford
B. wrightii (Gottsche) Steph.

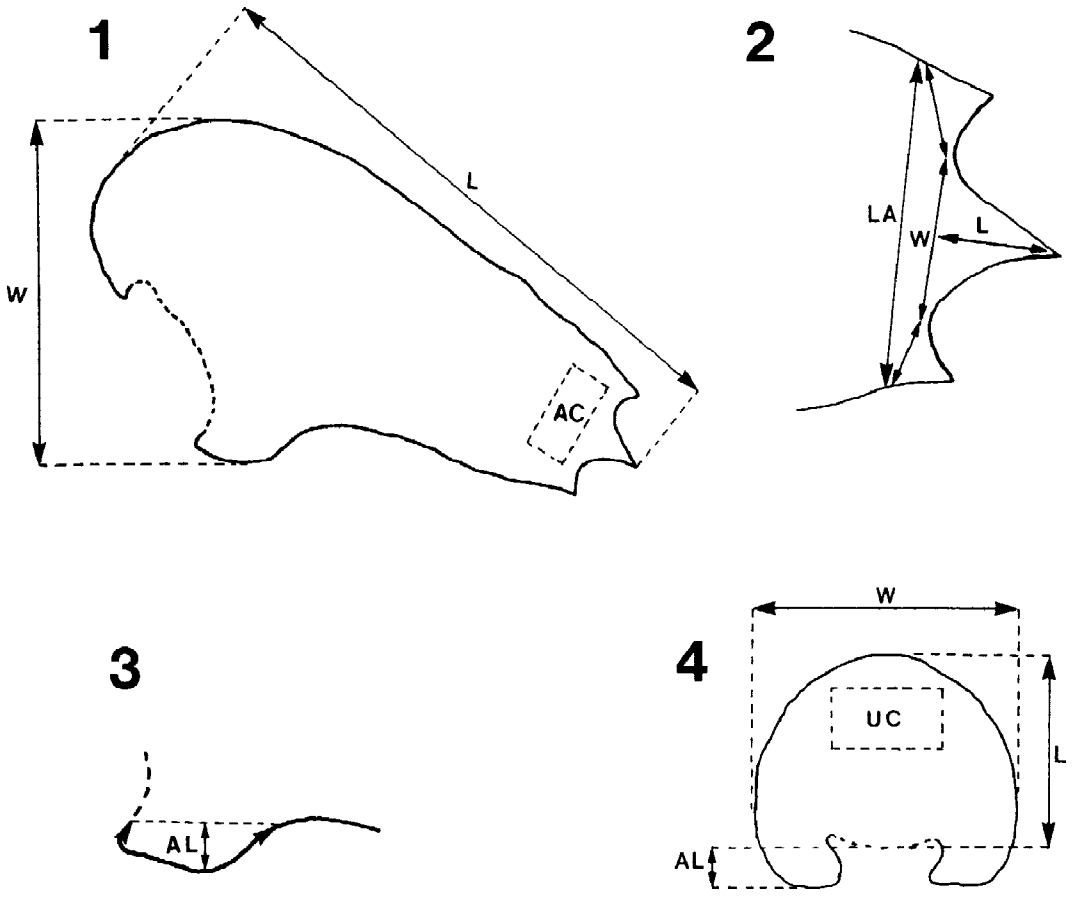

Figure 1: Guide to evaluation of measuring dates. 1. Lateral leaf; 2. Auricle of lateral leaf; 3. Apex and teeth of lateral leaf; 4. Underleaf; – AC: apical cells, AL: length of auricle, L: length, LA: leaf apex, UC: cells of underleaves, W: width.

Table 2: Size of trigones related to the terms used in the key.

Trigones	
used terms	size
minute to absent	0 µm - 4 µm
small	4 µm - 6 µm
conspicuous	6 µm - 15 µm
large	15 µm or more

Key to the main groups

1 Lateral leaves predominantly with 2 teeth (if 2 teeth and underleaves divided to the middle or more into long lobes or teeth see Group G - Fissistipulae) ..... Group A - Bidentatae

1' Lateral leaves predominantly with 3 teeth or rounded (if lateral leaves rounded see Group B 2 and 2', Group C 3 and 3', Group D 5 and 6)..... 2

2 Lateral leaves with a conspicuous ventral auricle, if auricle of lateral leaves

inconspicuous then auricle of underleaves large.....Group B - Appendiculatae and part of Grandistipulae

2' Lateral leaves without a conspicuous ventral auricle 3

3 Lateral leaves with a distinct vitta of elongate cells .....Group C - Vittatae

3' Lateral leaves without a distinct vitta. 4

4 Underleaves connate at the base with one or both lateral leaves, at least by few cells .....Group D - Connatae

4' Underleaves free from lateral leaves 5

5 Underleaves at least with cells few hyaline or with a hyaline border or hyaline throughout.....Group E - Grandistipulae with hyaline underleaves

5' Underleaves chlorophyllose throughout 6

6 Underleaves entire or divided to a maximum of one third of their length into lobes or teeth ..... Group F - Grandistipulae without hyaline underleaves

6' Underleaves divided to the middle or more of their length into lobes or teeth ..... Group G - Fissistipulae

Group A - Bidentatae

1 Lateral leaves at least at the base with a conspicuous distinctly delimited vitta 2

1' Lateral leaves without a vitta or vitta inconspicuous and not distinctly delimited 3

2 Vitta short, reaching about half of the leaf length; cells of the vitta 50 × 25 µm; trigones large (see Table 2) with bulging sides ..... *B. herminieri*

2' Vitta longer, reaching about two-third of the leaf length; cells of the vitta 40 × 15 µm; trigones small ..... *B. gracilis*

3 Teeth of lateral leaves short, 2-5 cells long; underleaves with the apex undulate to 4-lobed 4

3' Teeth of lateral leaves longer, 6-8 cells long; underleaves with the apex variously lobed or toothed 5

4 Trigones very large (see Table 2) with convex sides; underleaves large, about 0.65 mm long and 0.65 mm broad ..... *B. roraimensis*

4' Trigones conspicuous; underleaves small, 0.24 - 0.36 mm long and 0.24 - 0.36 mm broad ..... *B. cuneistipula*

5 Lateral leaves linear-lanceolate, 1.5-2 mm long and 0.3-0.5 mm broad; trigones large (see Table 2) with bulging sides; apical cells about 32 × 32 µm ..... *B. bidens*

5' Lateral leaves ovate elongate, 0.75-1.5 mm long and about 0.5 mm broad, trigones small to conspicuous; apical cells about 20 × 20 µm ..... *B. phyllobola*

Group B - Plants with a conspicuous Auricle (Appendiculatae and part of Grandistipulae)

1 Lateral leaves without teeth or faintly tridentate 2

1' Lateral leaves with teeth well developed 3

2 Lateral leaves with the sides parallel and the apex rounded, about 1.5 mm long and 0.95 mm broad at the base; trigones large; auricle of lateral leaves small;

underleaves large, 1.5-2 mm long, c. 1.5 mm broad ..... *B. placophylla*

2' Lateral leaves at the apex much narrower than at the base, apex rounded to lobed to faintly toothed, 2.5-3 mm long and about 1.5 mm broad; trigones small; auricle of lateral leaves large; underleaves smaller, c. 1.1 mm long and broad ..... *B. canelensis*

3 Lateral leaves 3.5-4 mm long and c. 2 mm broad, if smaller (3-3.5 mm long, c. 2 mm broad) then lateral leaves with large teeth and underleaves with teeth at the lateral margins 4

3' Lateral leaves 1.2-3 mm long and 0.8-2 mm broad, if larger then apical cells large, 32-36 × 24 µm 7

4 Trigones small 5

4' Trigones large 6

5 Lateral leaves very large, about 4 mm long and 2 mm broad at the base; stems rarely branched, if branched then diverging at a wide angle; ventral margin of lateral leaves curved; plants yellow-green ..... *B. schlimmiana*

5' Lateral leaves large, about 3.5 mm long and 2 mm broad at the base; branches diverging at an acute angle; ventral margin of lateral leaves nearly straight; plants olive-green to yellow-brown ..... *B. macrostipula*

6 Teeth of leaves large, 8-15 cells long, 4-6 cells broad; underleaves with long pointed teeth at the lateral margins; plants light-brown ..... *B. acanthostipa*

6' Teeth of lateral leaves smaller, to 6 cells long, 5-8 cells broad; underleaves with the lateral margins sinuate to toothed; plants deep yellow-brown to dark-brown ..... *B. falcata*

7 Trigones minute; underleaves variously toothed; auricle of lateral leaves often folded back forming a sac..... .....*B. denticulata*

7' Trigones conspicuous to large; underleaves entire or lobed but not toothed as above, auricle of lateral leaves never formig a sac 8

8 Trigones large 9

8' Trigones conspicuous 11

9 Auricle of lateral leaves inconspicuous and entire; underleaves with the base cordate and large auricles; teeth of leaves nearly as long as broad..... ..... *B. hookeri*

9' Auricle of lateral leaves and underleaves large, undulate to toothed; teeth of lateral leaves longer (8-15 cells) than broad (4-6 cells) 10

10 Apical cells of lateral leaves very large, 32-36 × 24 µm; underleaves small, c. 0.6 mm long and broad; plants deep-brown ..... *B. robusta*

10' Apical cells of lateral leaves small, c. 20 × 20 µm; underleaves larger, c. 1.2 mm long and broad; plants light-brown ..... *B. acanthostipa*

11 Lateral leaves only little longer than broad (c. 2.3 × 2 mm); underleaves longer than broad with large auricles with incised appendages .... *B. boliviana*

11' Lateral leaves conspicuously longer than broad; underleaves different from the description above 12

12 Underleaves conspicuously 4-lobed or toothed at the apex ..... *B. teretiuscula*

12' Underleaves not conspicuously 4-lobed or toothed 13

13 Auricle of lateral leaves rectangular, enlarged; underleaves mostly subrectangular, 0.6-1.4 mm long and 0.7-1 mm broad with the apex rounded entire to undulate or with a short tooth ..... *B. arcuata*

13' Auricle of lateral leaves undulate to lobed or toothed; underleaves mostly subquadrate, 0.6-0.85 mm long and broad with the apex and lateral margins undulate to lobed or toothed ..... *B. liebmanniana*

Group C - Vittatae

1 Teeth of lateral leaves large, 8-10 cells long, 4-6 cells broad; cuticle abundantly minutely punctate ..... *B. tayloriana*

1' Teeth of lateral leaves smaller, 1-5 cells long, 1-6 cells broad; cuticle not minutely punctate..... 2

2 Underleaves chlorophyllous throughout, with the apex entire to variously lobed or crenate; lateral leaves with small sharp teeth, 2-5 cells long, 2-6 cells broad ..... *B. spruceana*

2' Underleaves hyaline in part or throughout with the apex divided into 2-4 lobes or teeth; lateral leaves with the apex entire or with 3 small teeth, 1-2 cells long and 1-2 cells broad 3

3 Underleaves large, rectangular, 0.35 - 0.42 mm long and 0.28 mm broad, divided to one-fifth into 2 to 4 lobes or teeth ..... *B. heterostipa*

3' Underleaves small, subquadrate 0.28 mm long and broad, divided to one-half into 4 slender teeth ..... *B. nitida*

Group D - Connatae

1 Underleaves connate with a pair of lateral leaves 2

1' Underleaves connate only with one lateral leaf, at least with few cells 3

2 Underleaves with a border of 4-8 rows of hyaline cells the apex, mostly longer than broad, margin conspicuously serrate to dentate; apical cells 20-24 × 20-24 µm ..... *B. peruviana*

2' Underleaves chlorophyllose throughout or with a few cells hyaline or with 1-2 rows of cells forming a hyaline border at the apex, mostly broader than long, margin obscurely serrate or entire; apical cells 24-27 (or more) × 24 µm ..... *B. skottsbergii*

3 Underleaves without a hyaline border 4

3' Underleaves hyaline in part or with a hyaline border 5

4 Underleaves large, about 0.9 mm long and broad, connate with one leaf for one third of their width; trigones large; apical cells very small c. 16 × 16 µm ..... *B. fendleri*

4' Underleaves small, only little broader than the stem, narrowly connate with one leaf; trigones small to conspicuous; apical cells large, 25-30 × 22-25 µm ..... *B. cubensis*

5 Lateral leaves with the apex rounded entire (to faintly 2-3-lobed to toothed) with crenulate margin; underleaves small 0.34-0.38 mm long and 0.32-0.38 mm broad ..... *B. schwaneckiana*

5' Lateral leaves with the apex serrulate to spinose or 3-toothed; underleaves

larger 0.48 - 0.56 mm long, 0.48 - 0.64 mm broad 6

6 Underleaves with a hyaline border reaching the base; apex of lateral leaves blunt serrulate to spinose; apical cells c. 18 × 18 µm ..... *B. pycnophylla*

6' Underleaves with a hyaline border only at the apex sometimes reaching the lateral margins but not the base; apex of lateral leaves with short teeth; apical cells c. 25 × 25 µm 7

7 Hyaline border of underleaves only across the top; teeth of lateral leaves small, 2-5 cells long, 1-5 cells broad with the margins coarsely serrate ..... *B. armatistipula*

7' Hyaline border of underleaves across the top and sometimes along the lateral margins; teeth of lateral leaves very small, 1-3 cells long, 2-4 cells broad with the margins entire to faintly serrate ..... *B. eggersiana*

Group E - Grandistipulae with hyaline underleaves

1 Trigones minute or absent; leaf cells quadrate 2

1' Trigones small to large; leaf cells with the lumina angular-rounded to stellate 3

2 Underleaves quadrate to longer than broad, hyaline throughout or with a small area of chlorophyllose cells at the base ..... *B. affinis*

2' Underleaves round-quadrate, hyaline in part with the hyaline area of the underleaves of a stem varying in size and position ..... *B. taleana*

3 Lateral leaves large, 2.25-3 mm long and very broad (1.5-1.6 mm); underleaves large, 0.6-1 mm (or more) long and 0.7-1 mm broad 4

3' Lateral leaves smaller, 1.4-2.3 mm long and 0.5-0.6 mm broad at the base; underleaves smaller, 0.42-0.5 mm long and 0.34-0.5 mm broad 5

4 Underleaves with a hyaline border of 4 or more rows of cells reaching the base, hyaline part with inconspicuous trigones, chlorophyllose part with conspicuous trigones; lateral leaves with teeth mostly unequal and conspicuous trigo..... *B. stolonifera*

4' Underleaves with some cells of the margin hyaline or chlorophyllose throughout; lateral leaves with 3-4 teeth and small trigones .. *B. chimborazensis*

5 Teeth of lateral leaves very large, 8-12 cells long and 5-10 cells broad; hyaline border of the underleaves broader at the apex (2-4 rows of cells) than at the lateral margins (1-2 rows of cells), reaching the base ..... *B. chilensis*

5' Teeth of the lateral leaves smaller, 3-8 cells long and 3-6 cells broad; underleaves hyaline in part but not as above..... 6

6 Hyaline border of underleaves narrow to broad, reaching the base; underleaves round-quadrate with the apex straight, crenulate; lateral leaves with 1-3 teeth, serrulate at the margin ..... *B. serrata*

6' Hyaline border of underleaves only at the apex or sometimes underleaves hyaline throughout; underleaves elongate with the apex variously lobed to toothed; lateral leaves variable, with 3-4 teeth ..... *B. pallide-virens*

Group F - Grandistipulae without hyaline underleaves

1 Lateral leaves small, about 1 mm long and 0.5-0.6 mm broad; underleaves small, 0.28-0.36 mm long and 0.28-0.45 mm broad; trigones small to conspicuous; lateral leaves often irregular 1-3 toothed 2

1' Lateral leaves larger, (1-)1.5-2.5(-3) mm long and 0.5-1.5 mm broad, if shorter than 1.5 mm then trigones minute (see *B. taleana* 6'); teeth of lateral leaves generally regular, rarely irregular 1-2 or 3-4 toothed 5

2 Apical cells small c. 17 × 17 µm ..... *B. diversicuspis*

2' Apical cells larger, 20-26(-30) × 22-24(-30) µm 3

3 Underleaves very small, about 0.28 mm long and broad; cell walls thickened along the margin; lateral leaves and underleaves distant ..... *B. tricuspidata*

3' Underleaves larger, 0.35-1 mm long and 0.35-0.7 mm broad; cell walls not thickened along the margin; lateral leaves and underleaves distant to approximate to imbricate 4

4 Trigones conspicuous; branches diverging at a wide angle; underleaves 0.35-1 mm long and 0.35-0.7 mm broad ..... *B. longistipula*

4' Trigones small; branches diverging at an acute angle; underleaves about 0.35 mm long and 0.45 mm broad ..... *B. tricrenata*

5 Trigones minute to absent 6

5' Trigones small to large 7

6 Underleaves subquadrate, variously toothed, spinose to ciliate; lateral leaves with the margin entire to dentate ..... *B. denticulata*

6' Underleaves round-quadrate, with entire lateral margins, apex entire to undulate; lateral leaves with the margin entire ..... *B. taleana*

7 Trigones large 8

7' Trigones small to conspicuous 14

8 Underleaves with the apex mostly distinctly 4-lobed 9

8' Underleaves with the apex undulate to toothed 10

9 Underleaves elongate, 1-1.5 mm long and 0.5 mm broad; lateral margins parallel and entire; apical cells large, 36-45 × 27 µm; teeth of lateral leaves sometimes with a uniseriate tip of 2-6 cells ..... *B. elongata*

9' Underleaves subquadrate, about 0.56 mm long and 0.7 mm broad; lateral margins lobed; apical cells small, c. 22 × 22 µm; teeth of lateral leaves short acute ..... *B. quadricrenata*

10 Apical cells very large, c. 45 × 27 µm ..... *B. crassidentata*

10' Apical cells smaller, 20-36 × 20-27 µm 11

11 Apex of underleaves with a short incurved tooth at either end and lobed inbetween 12

11' Apex of underleaves rounded to faintly 2-4-lobed or irregularly lobed and toothed 13

12 Underleaves small 0.48-0.55 mm long

and broad; apical cells large, 27-36 × 24-27 µm; ventral margin of lateral leaves curved ..... *B. sublonga*

12' Underleaves larger 0.7-0.85 mm long and 0.6-0.7 mm broad; apical cells smaller 20-24 × 20-24 µm; ventral margin of lateral leaves nearly straight ..... *B. glaziovii*

13 Underleaves with margin entire, apex entire to faintly lobed; plants dark red-brown ..... *B. longa*

13' Underleaves with margin and apex irregularly toothed and lobed; plants green-brown ..... *B. aurescens*

14 Underleaves with the lateral margins strongly recurved ..... *B. acuminata*

14' Underleaves with the lateral margins not strongly recurved 15

15 Underleaves concave when seen from above, and / or apex of underleaves with large elongate cells with intermediate thickenings 16

15' Underleaves plane, not with the characters above 17

16 Underleaves very concave, reniform, inflated when seen from above and with the margin appressed to the stem ..... *B. jamaicensis*

16' Underleaves plane to concave, slightly squarrose, apex of underleaves with large elongate cells with thin cell-walls, large trigones and intermediate thickenings ..... *B. wrightii*

17 Apex of underleaves variously lobed to toothed 18

17' Apex of underleaves entire to slightly 2-4-lobed 19

18 Cells of underleaves 24-36 × 20 µm; margin of teeth of lateral leaves entire ..... *B. pallide-virens*

18' Cells of the underleaves 18-22 × 18 µm; margin of teeth of lateral leaves obscurely serrate ..... *B. chimborazensis*

19 Apical cells large 24(-30) × 24(-30) µm; lateral leaves ascendent with 1, 2 or 3 teeth ..... *B. longistipula*

19' Apical cells smaller 20-24 × 20-24 µm; lateral leaves spreading, with 3 teeth 20

20 Plants golden brown; underleaves elongate, 0.6-0.9 mm long and c. 0.55 mm broad, with the lateral margins nearly parallel ..... *B. latidens*

20' Plants olive green to faintly brown; underleaves subquadrate, 0.8-1 mm long and 0.65-1 mm broad, with the lateral margins slightly convex ..... *B. breuteliana*

Group G - Fissistipulae

In this section there is only one species in Latin America. It can be easily distinguished from all other species, because of its underleaves which are divided to the middle or more into usually four lobes or teeth ..... *B. chimantensis*

Acknowledgements

I wish to express my gratitude to Maria I. Morales Z., University of Costa Rica, for kindly providing working place and helpful discussions and to FLAS for the loan of specimens. My thanks are also due to Peter Döbbeler, for his advice in critical questions, to Tamás Pócs for using and testing the key and to the DAAD (German Academic Exchange Service) for the grant which facilitated the studies at the University of Costa Rica.

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