# Studies of Leaf Epidermis in Bothriochloa, Capillipedium and Dichanthium

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That leaf epidemis is a useful character in the taxonomy of grasses has been demonstrated by Prat (1932, 1960), Tateoka *et al.* (1959) and Metcalf (1960). Some members of the three related genera *Bothriochloa, Capillipedium* and *Dichanthium,* and their natural hybrids, were studied to see how much information leaf epidermis could furnish concerning relationships between these taxa.

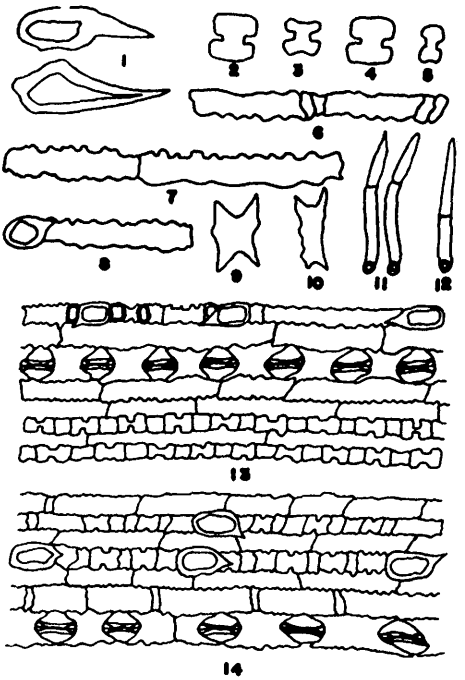
***Materials and Methods.*** Leaves from herbarium specimens were placed in 1:1 solution of glycerine and ethyl alcohol. After 2 to 3 days, epidermal slides were prepared by placing a part of the leaf on a glass slide, with the epidermis to be studied facing downwards. All the tissue above this epidermal surface was scraped off with a sharp blade, and the remaining epidermal layer was mounted in lactic acid. The cover glass was sealed with transparent nail polish.

***Results.*** The leaf epidermis of grasses is composed of a number of cell structures (Figs. 13 and 14). Over the veins, silica cells show a great deal of variation (Figs. 2-5). In *B. longifolia, B. ischaemum, B. ewartiana, D. annulatum* and *C. spicigerum,* silica cells are commonly narrow (Fig. 5). *B. caucasica,* on the other hand, shows broad (Figs. 2 and 3) silica cells. In the other species both the types are commonly encountered.

Short cells and long cells (Fig. 6) are present both over the veins and in between the veins. In *D. annulatum* and *B. intermedia* × *D. annulatum* short cells are longer than broad (Fig. 7) and may be as many as five in a row. In the other species they are either solitary (Fig. 14) or in pairs (Fig. 6) and broader than long or equidimensional. Long cells may be pitted or nonpitted (Table I).

The interstomatal cell may be short and broad (Fig. 9) or long and narrow (Fig. 10), but usually both the types are present in the same species (Fig. 14), hence it is not a very reliable character. Short interstomatal cells are abundant in *B. longifolia, B. ewartiana, B. ischaemun, D. annulatum* and *C. spicigerum*. The rest of the species studied have a greater frequency of long interstomatal cells.

Bicellular microhairs are found in all the species of the three genera studied. Vickery (1935) and Metcalf (1960) did not find bicellular microhairs in members of the genus *Capillipedium*. Two species, *C. spicigerum* and *C. parviflorum* were checked with respect to this character and bicellular microhairs were present in both. The two species also possess frequent long macrohairs which may over shadow small microhairs. This may explain why previous workers missed this character. The ratio of basal/distal cell length is highest in *D. annulatum*. In *B. longifolia, B. ewartiana, B. caucasica* and *B. intermedia* × *D. annulatum* this ratio is more than 1.00. (Fig. 11, Table I.) The other species studied have less than 1.00 ratio of the two cells of bicellular microhairs (Fig. 12, Table I).




Legend to Figures 1-14

1. "A" type prickle hairs in *B. caucasica*. 2-3. Broad silica cells in *B. caucasica*. 4. Broad silica cell in *B. intermedia* × *D. annulatum*. 5. Narrow silica cells in *B. longifolia*. 6. Long-cells and short cells in *B. longifolia*. 7. Long-cell and short cell in *D. annulatum*. 8. Short cell modified in "B" type prickle hair in *B. longifolia*. 9-10. Interstomatal cells in *B. longifolia* and *C. spicigerum* respectively. 11-12. Bicellular microhairs in *D. annulatum* and *B. odorata* respectively. 13-14. A portion of leaf epidermis in *B. ischaemum* and *B. odorata* respectively. Magnifications for figures 1-12 275X; 13-14 180X

Prickle hairs with swollen bases and curved tips are unicellular. These could be divided into two types according to their origin and distribution. Type "A" originates over the veins from the rows of cork cells and silica cells. It is present in *B. caucasica, C. spicigerum* and *D. annulatum*. Type "B", originates from the short cells and is present in *B. longifolia, B. ischaemun* and *B. ewartiana*. The other species have both types of prickle-hairs. However, there are differences in size, and in relative abundance of the two types of hairs in different species. The presence and relative abundance of these two types of microhairs are represented by plus signs (Table I). The "A" type prickle hairs are also relatively larger than the "B" type. In this respect *B. odorata* and *B. intermedia* × *Capillipedium* are similar to *B. caucasica* or *Capillipedium*.

## Discussion and Conclusions

In general, the epidermal pattern shows a great deal of similarity between the members of the three genera. However, certain anatomical differences do exist which could be used in showing relationships between different species as well as their hybrids.

In the genus *Bothriochloa* the three species, *B. longifolia, B. ewartiana* and *B. ischaemum*, show remarkable similarities in their epidermal characteristics . These are also similar morphologically.

The two species, *B. caucasica* and *B. odorata* and the natural hybrids of *B. intermedia* × *Capillipedium*, as mentioned earlier, have the prickle-hairs of the same origin, size and frequency as in *Capillipedium*. In this respect these are different from other *Bothriochloa* species studied. Nevertheless *B. caucasica* also shows some degree of specialization with respect to silica cells and bicellular microhairs. *B. caucasica* is also ecologically specialized and geographically isolated. Morphologically *B. caucasica* and *B. odorata* possess non-pitted glumes with conspicous grooves and cilia, long primary axes, short racemes with few spikelet pairs, long sterile zones, on primary branches of inflorescence and numerous secondary branches, showing morphological similarities with *Capillipedium*. As hybridization seems to be a characteristic feature of evolution in this group (Celarier 1957, Celarier *et al.* 1958, Harlan *et al.* 1958, Borgaonkar and de Wet 1960), the two species *B. odorata* and *B. caucasica* could be the products of hybridization between some members of the genus *Bothriochloa* with that of *Capillipedium*. Anatomy alone is not sufficient to draw this conclusion, but morphological data (to be published elsewhere) have indicated that such an origin of the two species is possible.

The genus *Dichanthium* is quite distinct in having a high ratio of basal/distal cell length ratio of bicellular microhairs, and 4-5 long short-cells in a row. The natural hybrids of *B. intermedia* × *Dichanthium annulatum* show an intermediate condition between the two parents regarding these characters. In this case, the anatomical characters seem to be of greater value and could be used the same way as morphological characters in the study of hybrids. In *B. intermedia* × *B. ischaemum* hybrids the frequency and nature of the types of prickle hairs together with other characters (Table I) may be used for identification. However, the differences here are not as clear as in previous cases . This indicates that epidermal characters are more useful in intergeneric than interspecific hybrids.

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Table I. LEAF EPIDERMIS IN BOTHRIOCHLOA, CAPILLIPEDIUM, DICHANTHIUM AND THEIR NATURAL HYBRIDS

| | Short Cells | Long Cells | Bi-Cellular Microhairs Mean length in mms. | Ratio. basal/distal cell | Prickle Hairs 'A' type | 'B' type | Silica Cells Ratio. length/breadth |
|---|---|---|---|---|---|---|---|
| *B. longifolia* (Hack.) Bor | short 1-2 | — | 0.041 | 1.36 | — | + | 2.00 |
| *B. ischaemum* (L.) Keng | do | Pitted | 0.055 | 0.77 | — | ++ | 2.00 |
| *B. intermedia* × *B. ischaemum* | do | — | 0.050 | 0.78 | + | ++ | 1.22 |
| *B. ewartiana* (Domin) C. E. Hubbard | do | — | 0.057 | 1.25 | — | + | 1.44 |
| *B. intermedia* (R. Br.) A. Camus | do | — | 0.060 | 0.84 | + | + | 1.32 |
| *C. spicigerum* S. T. Blake | do | Pitted | 0.070 | 0.85 | ++ | — | 1.60 |
| *B. intermedia* × *Capillipedium* | do | — | 0.063 | 0.83 | ++ | + | 1.33 |
| *B. caucasica* (Trin.) C. E. Hubbard | do | Pitted | 0.056 | 1.28 | ++ | — | 1.09 |
| *B. odorata* (Lisboa) A. Camus | do | do | 0.060 | 0.79 | ++ | + | 1.48 |
| *D. annulatum* (Forsk.) Stapf | short-long 4-5 in row | do | 0.073 | 1.80 | ++ | — | 1.69 |
| *B. intermedia* × *D. annulatum* | short-long 1-5 in row | do | 0.058 | 1.20 | ++ | + | 1.33 |

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