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Structure and Taxonomic Value of the Dewlap in Sugarcane¹

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GENERAL MORPHOLOGY

Just above the ligule in a blade joint of mature sugarcane are two generally deltoid or squarish areas that differ in color and internal structure from the lamina. The tips or inner margins of the two blade-joint hinge areas almost meet on the back surface of the midrib (fig. 1, *A*).

The hinge areas are referred to in sugarcane literature as dewlaps or joint triangles. With reference to some wild clones, where the lamina is no wider than the midrib, the terms "transverse markings" and "ligular bands" have been used by Indian scientists.

The dewlaps form the hinge of the blade joint. To give the blade mobility, the dewlap surfaces are slightly ruffled, the sclerenchymatous bundle caps being replaced by collenchyma. The resulting softer structure often causes older dewlaps to break and tear. There is a certain amount of variation in the form and the surface markings of dewlaps, but on the whole those of a given clone have a characteristic pattern. The shape varies somewhat in a given culm. Also, the dewlaps of a given leaf, especially those near the top of the culm, are asymmetric; the one associated with the overlying sheath margin is likely to be taller and less steeply sloping than the other.

The shape of the dewlap is commonly deltoid or squarish, with the base line horizontal (fig. 1, *B*) or sloping (fig. 1, *C* to *E*). When the base line parallels the upper margin the dewlap appears rectangular or rhomboid, but when the margins converge in the direction of the midrib the form is deltoid, or crescent-deltoid if the margins are also

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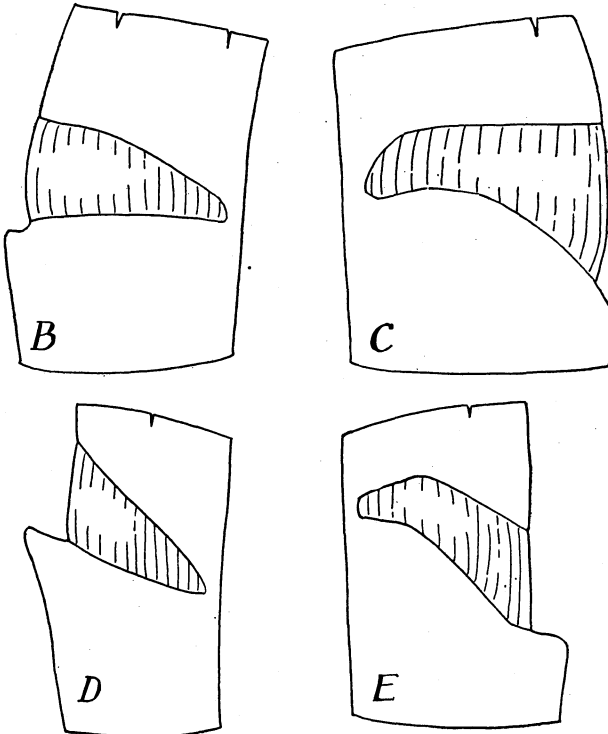
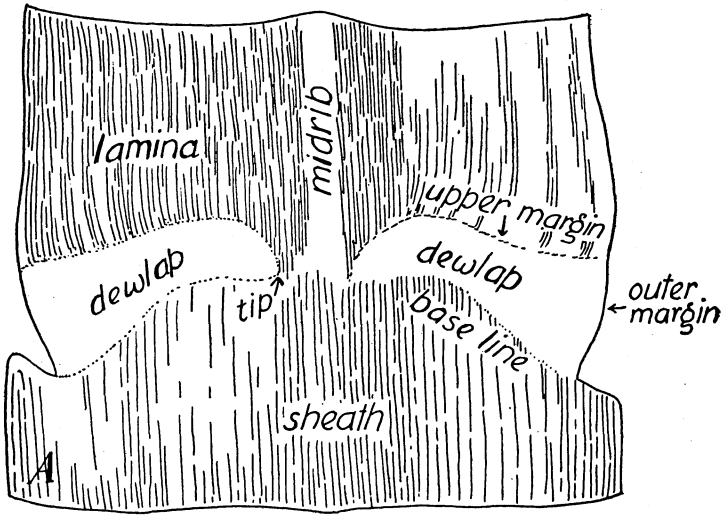


FIGURE 1.—A, Abaxial side (outer surface) of a flattened blade joint with dewlaps and adjoining sheath and blade parts; B, deltoid dewlap with horizontal base line; C, squarish-subcrescent dewlap with horizontal upper margin and downward-sloping base line; D, deltoid dewlap with downward-sloping base line and upper margin; E, squarish-ligulate dewlap with ascending tip and downward-sloping lower margin.

curved. Wavy upper and lower margins produce various patterns. The more commonly recurring types, found chiefly in the clones of noble cane, are shown in figure 2.

Young dewlaps are concolorous with the lamina, usually a pale green; in a few clones, such as those of Molokai 5099, Imp.² 1012, they are bright red. As the leaf matures the dewlap color deepens, changing to olive, olive brown, or darker tones. The color as a rule is solid, but occasionally there is an edging of red or yellow, especially noticeable in young dewlaps.

The outer surface of the young dewlap is glabrous or slightly glaucous; that of the older dewlap is usually covered with wax. The wax deposit is white but becomes discolored on aging, thus contributing to the changes in dewlap color already in progress. In some clones the wax deposit is thick; in others, a barely noticeable bloom.

PUBESCENCE OF THE DEWLAP

Both surfaces of the dewlap are clothed with hair. The hairs on the inner side (adaxial) are usually dense, diversified, and visible to the naked eye. The pubescence on the outer side (abaxial) is, as a rule, inconspicuous and often hidden under a layer of wax. The edge of the dewlap is ciliate. The cilia are confluent with the long marginal hairs of the ventral surface pubescence. The importance of the dewlap pubescence in sugarcane taxonomy was recognized early by Dutch investigators in Java, notably by Jeswiet (5, 6, 7),³ and this character was utilized in classifying the cultivated and indigenous varieties. To the types of hair groups described and named by Jeswiet, a number of variants have been added by the author. Some of these have been briefly characterized in earlier publications (2, 3) but receive detailed treatment in the present study.

PUBESCENCE ON OUTER SURFACE

The outer, or dorsal, surface of the dewlap may be nearly glabrous or covered with a feltlike pubescence. Some varieties have in addition regionally restricted groups of long hairs directly inserted on the dewlap surface or occasionally projecting as a pseudo covering from the adjacent sheath region.

Hair group 58 (Jeswiet).—The hairs of this group are short, feltlike, and often hidden under a layer of wax (fig. 3, A). Because the dewlaps lack the prominent venation of sheath and blade, the dorsal hairs appear uniformly scattered, but occasionally their distribution has a definite banded pattern. When the pubescence is sparse, the hairs are often concentrated in the marginal zone, but occasionally they are densest in the triangle near the midrib. The hairs are short and appressed; occasionally they are more prominent. When such semilong hairs of group 58 are present on the outer dewlap surface, there will be a similar, but more pronounced, increase in hair length on the inner surface.

² Importation number (Imp.) assigned by Division of Sugar Plant Investigations.

³ Italic numbers in parentheses refer to Literature Cited, p. 12.

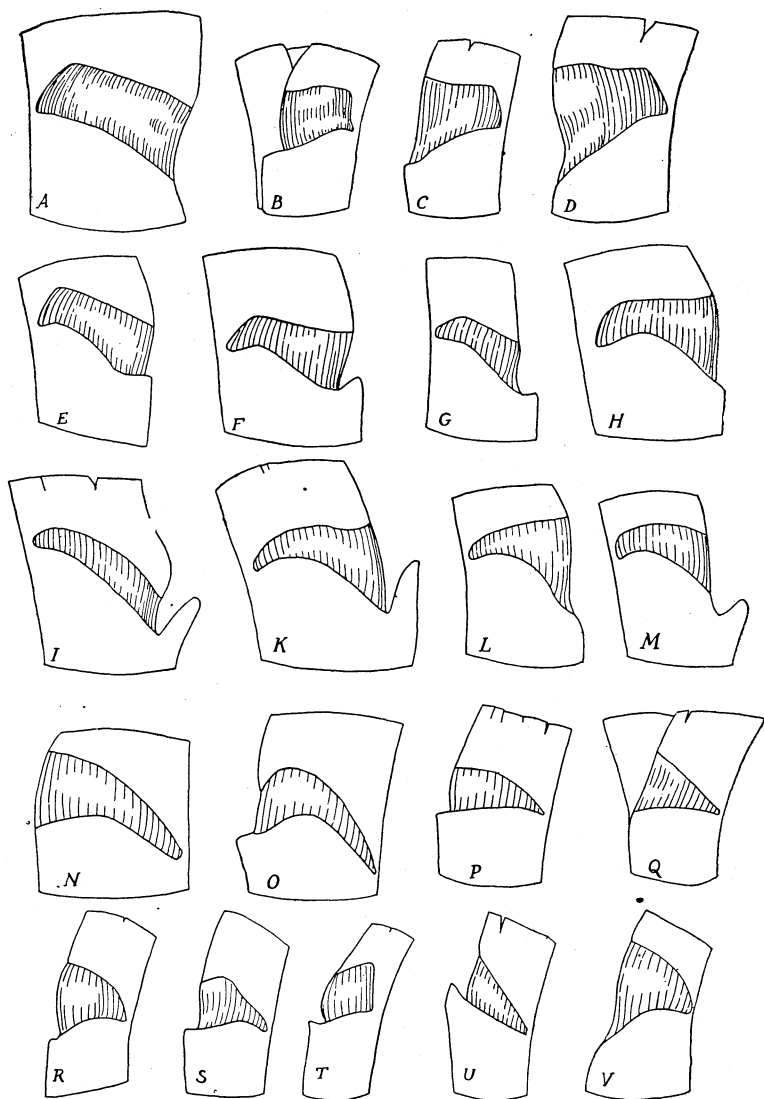


FIGURE 2.—Common dewlap patterns in various clones: A, Large ascending squarish or rhomboid, New Caledonia 11, Imp. 880; B, tall and short squarish, 14 N. G. 241, Imp. 623; C, tall and short squarish-subrescent, 14 N. G. 124, Imp. 624; D, large and tall, short squarish-subrescent, 96 N. G. 24, Imp. 227; E, ascending medium-tall squarish, 28 N. G. 46, Imp. 373; F, ascending medium-tall ligulate, 28 N. G. 84, Imp. 649; G, ascending narrow ligulate, Toledo, Imp. 56; H, squarish-subrescent, 28 N. G. 203, Imp. 655; I, steeply ascending narrow ligulate, Barbados, Imp. 698; K, ligulate-subrescent, 28 N. G. 261, Imp. 500; L, tall deltoid-subrescent, 28 N. G. 97, Imp. 503; M, crescent-subrescent, Manjav, Imp. 95; N, descending narrow deltoid-crescent, Co. 281; O, steeply descending crescent, 28 N. G. 213, Imp. 659; P, shallow deltoid-crescent with straight basal margin, 28 N. G. 17, Imp. 526; Q, equilateral deltoid, 21 N. G. 14, Imp. 320; R, tall and short deltoid-crescent, Hitam Rokan, Imp. 1061; S, tall and short ligulate, 28 N. G. 40, Imp. 369; T, tall and short rhomboid, T. M. 85, Imp. 1339; U, descending deltoid, Ganapathy, Imp. 1491 (a pattern typical of many clones of *Saccharum spontaneum* and *S. barberi*); V, tall and short deltoid-crescent, subrescent, 28 N. G. 36, Imp. 476.

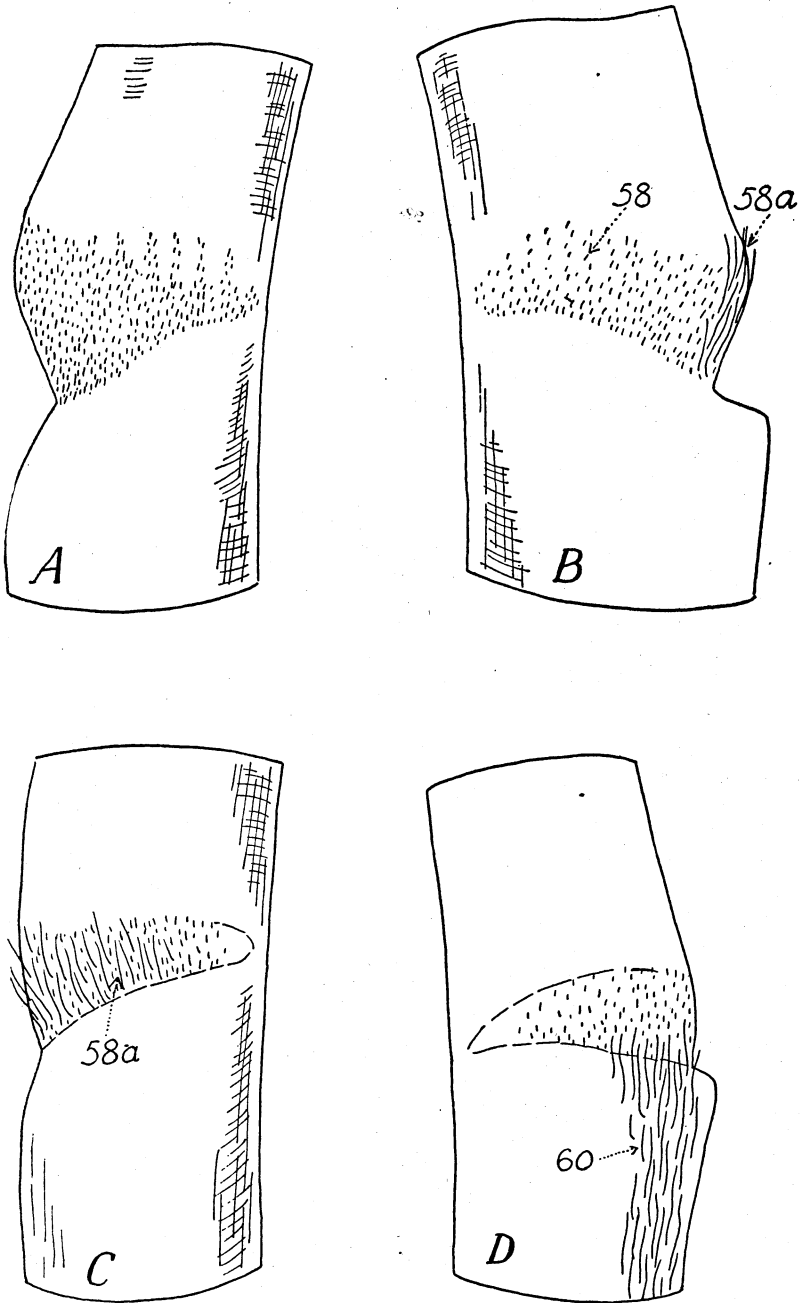


FIGURE 3.—Types of pubescence on outer surface: A, Dewlap with hair group 58; B, dewlap with marginal group 58a; C, long hairs of group 58a nearly covering dewlap surface; D, dewlap with hairs of group 60 forming a pseudo 58a (a false group produced by the extension of sheath hairs over the base line of the dewlap).

Hair group 58a (new group).—This group was first observed by the writer in clones of *Saccharum spontaneum* and *S. robustum* (2, 3), and subsequently among varieties of noble canes. The hairs are long and mostly marginal (fig. 3, *B*). In a few clones they are implanted on a wider base and may cover most of the dewlap surface. They are not as long as the marginal hairs of the inner dewlap pubescence, with which they are in juxtaposition. Because of its marginal implantation, the group is observed to best advantage in young protected organs; even here a poorly developed group may be easily overlooked.

In certain clones with hairy sheaths, the hairs of group 60 (1) may project over the base line of the dewlap, forming a pseudo 58a (fig. 3, *D*). This group is frequently observed in the Molokai clones of *S. robustum*, alone or in association with group 58a.

PUBESCENCE ON INNER SURFACE

The upper or inner surface of the dewlap has a short feltlike pubescence (fig. 4, *A*), which is covered by long silky lashes toward the outer edge. The leaf edge above the dewlap has shorter lashes that change into spines in the higher parts.

Hair groups 52 and 52a (Jeswiet, modified).—The short hairs making up group 52 usually cover the entire surface of the dewlap. They may extend to the midrib and occasionally partly or completely across it to form group 52a. Group 52 varies greatly in degree of hair density among different clones (fig. 4, *B, C*), but it is never entirely wanting. The hairs occur in bands between the veins or they are uniformly scattered and often matted. They are unicellular, appressed, short, and, occasionally, longer than normal for the group (fig. 4, *D*).

Hair group 51 (Jeswiet).—The short hairs of group 52 are covered entirely or marginally (fig. 5, *A to D*) by long hairs that continue as lashes which project prominently over the outer edge of the dewlap. In most clones, the hairs are implanted so low that some remain attached to the ligular flange when the ligule is stripped off the blade joint for examination. Occasionally the hairs are implanted slightly higher, leaving a narrow hair-free strip between dewlap base and ligule. The basally implanted hairs of group 51 are longest and most conspicuous and cover up the shorter lashes inserted progressively higher on the dewlap surface. The relative length of the lashes remains uniform or shows a gradual decrease in the direction of the midrib. The prominence of the group is governed by the length of the hairs and the width of the insertion base. In the clones of *Saccharum sinense* and *S. barberi* the lashes are short and arise from a narrow base (fig. 4, *E*). In other clones the tufts have a wider base (fig. 5, *B*) and may extend as far inward as the midrib (fig. 5, *C*). The hairs are usually spaced evenly; occasionally they are bunched (fig. 5, *E*) as in 32-C-73, Imp. 565.

Hair group 51a (new group).—In some varieties the larger part of the ventral surface of the dewlap is clothed with medium-long hairs implanted basally but also higher up on the dewlap surface (fig. 5, *D*). Such dewlaps usually have conspicuous corner tufts, while the short hairs of group 52 are masked by the longer hairs of the new group (New Caledonia 29, Imp. 889). In other clones the corner groups are more sharply delimited from group 51a, as exemplified by 28 N. G.

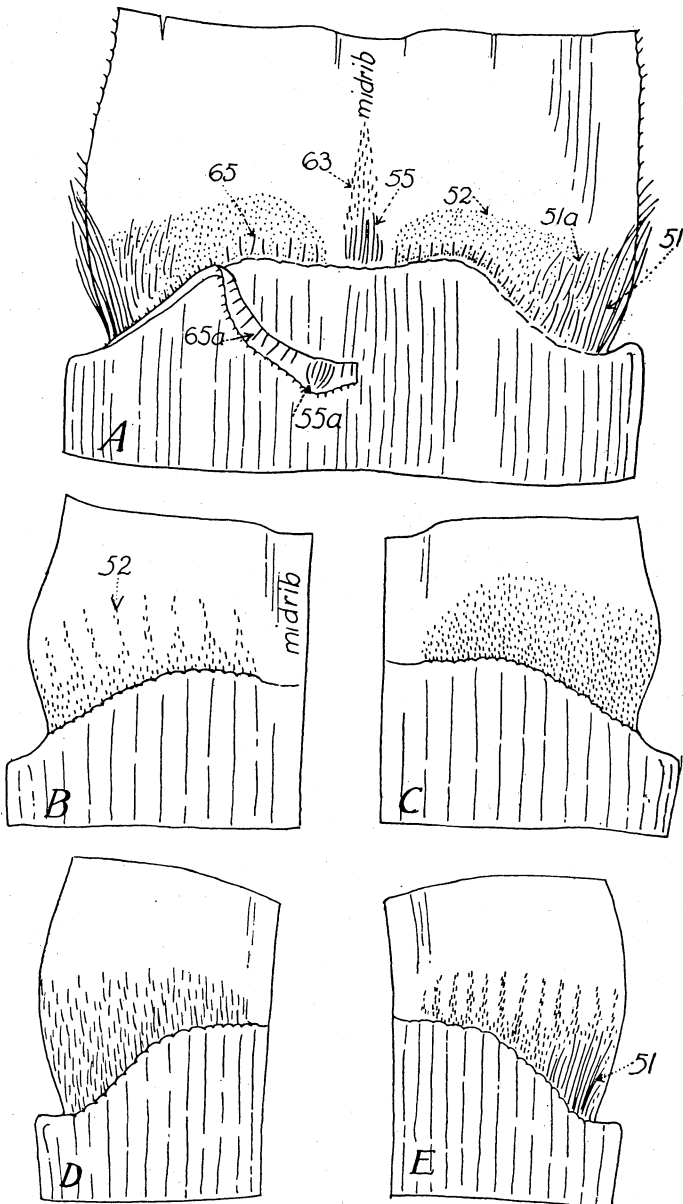


FIGURE 4.—Pubescence on inner surface of the dewlap: *A*, Flattened blade joint with dewlaps and adjoining sheath and blade parts, showing the various hair groups; *B*, inner surface of dewlap with sparsely developed group 52; *C*, dewlap with feltlike development of group 52; *D*, dewlap with hairs of group 52 longer than is normal for the group; *E*, dewlap with well-developed group 52 and smaller marginal group 51.

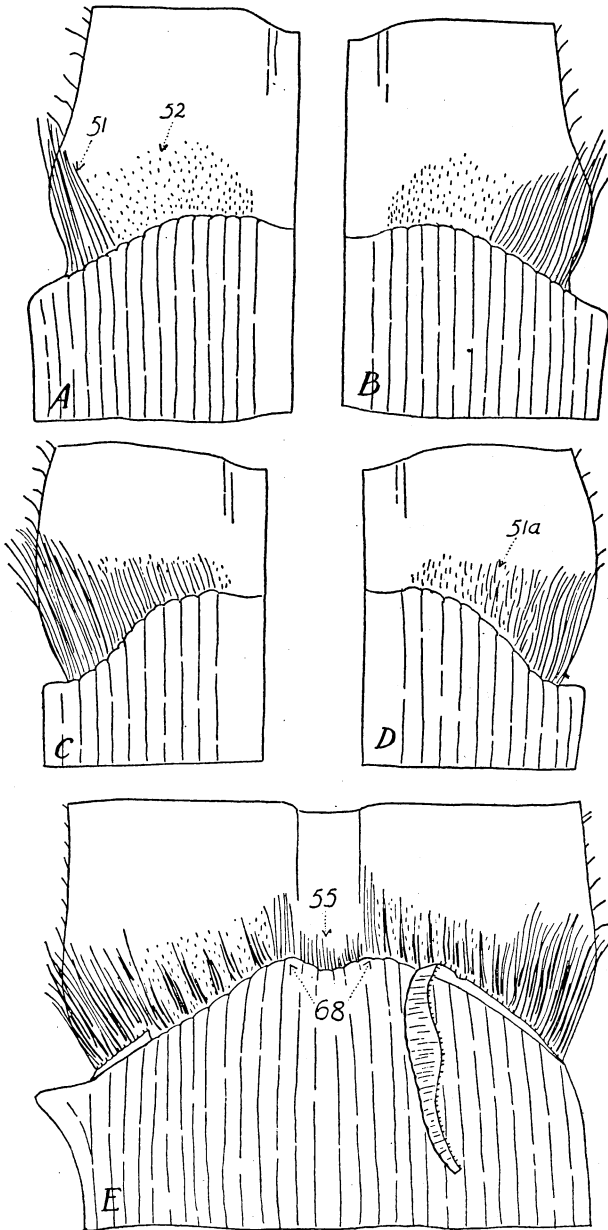


FIGURE 5.—Pubescence on inner surface of the dewlap: *A*, Inner surface of dewlap with prominent marginal group 51; *B*, prominent group 51 implanted on a broad base; *C*, group 51 extending as far as midrib; *D*, dewlap with groups 51 and 51a; *E*, flattened blade joint with adjoining sheath and blade parts. The long hairs of group 51 are bunched along the veins and extend as far as the midrib. In some leaves the hairs are especially prominent along the two edges of the midrib, producing group 68; shorter hairs of group 55 extend through the midrib and connect the two groups 58, giving the groups in their entirety a two-pointed brush effect (clone 32-C-73, Imp. 565).

204, Imp. 659, Caledonia Ribbon, Imp. 1239, and Brava de Perico, Imp. 766. Borderline forms must be evaluated on their own merits; a weakly developed group 51, especially if inserted on a broad base, could easily be identified with the new group. In clones with well-developed groups 51 and 51a, the entire dewlap pubescence usually is prominent.

Hair group 65 (Jeswiet, modified).—According to Jeswiet (5), group 65 is a single row of hairs not exceeding the ligule in height, inserted immediately behind it and extending over the entire width of the leaf blade. However, Jeswiet (6, 7) limits the group to the region of the midrib and uses it practically synonymously with midrib group 55. In its present definition, group 65 forms a narrow file of hairs, approaching and usually exceeding the ligule in height, implanted immediately behind it and extending between leaf edge and midrib but rarely across it (fig. 4, A). Group 65 is closely associated with group 65a of the ligule (4). The hairs of this group are tall, free, and in juxtaposition with 65; they are taller than the ligule, especially in the flange zone.

MIDRIB PUBESCENCE

In many sugarcane varieties the midrib region between the two dewlaps is smooth (fig. 6, A); in others it has a sparse or prominent pubescence. The midrib hairs form discrete groups or more often represent an extension of the dewlap pubescence into the midrib (group 52a). Most common is the extension of group 52 (fig. 6, B), limited to a few scattered hairs hardly noticeable even in young organs or as pronounced as the dewlap pubescence itself. The hairs are inserted directly behind the ligule and may range upward for a shorter or longer distance. In some clones of *Saccharum spontaneum*, where the entire dewlap surface is covered with long or semilong lashes, an extension of the hairs into the midrib is very common.

Hair group 55 (Jeswiet).—This group forms a prominent tuft of long or semilong hairs the width of the midrib or narrower (fig. 6, E). It is usually discrete, but in clones that have hair group 65 it is in lateral continuity with that group. If hair group 55a of the ligule is also present, it is in juxtaposition with that group. Group 55 occurs frequently in clones of *S. barberi* and *S. robustum*, as well as in a number of noble canes. It is absent from the *S. sinense* group.

Hair group 63 (Jeswiet).—This group is composed of short hairs inserted on the midrib immediately behind the ligule (fig. 6, C). It forms a deltoid or linear patch of variable length and prominence. It rarely occurs independently but usually in association with group 55 (fig. 6, F). In clones where group 52 extends into the midrib, group 63 represents an acropetal extension of it (fig. 6, D). The hairs are almost always short and appressed, inserted somewhat obliquely, and show up to the naked eye by their silvery sheen. In some few clones with abundant dewlap pubescence, group 63, if present, is made up of longer hairs.

Hair group 68 (Jeswiet, modified).—This group may be considered an aberrant form of group 51. It is composed of two tufts of long hairs implanted on the edges of the midrib directly behind the ligule. The two tufts are connected across the midrib by a strip of shorter

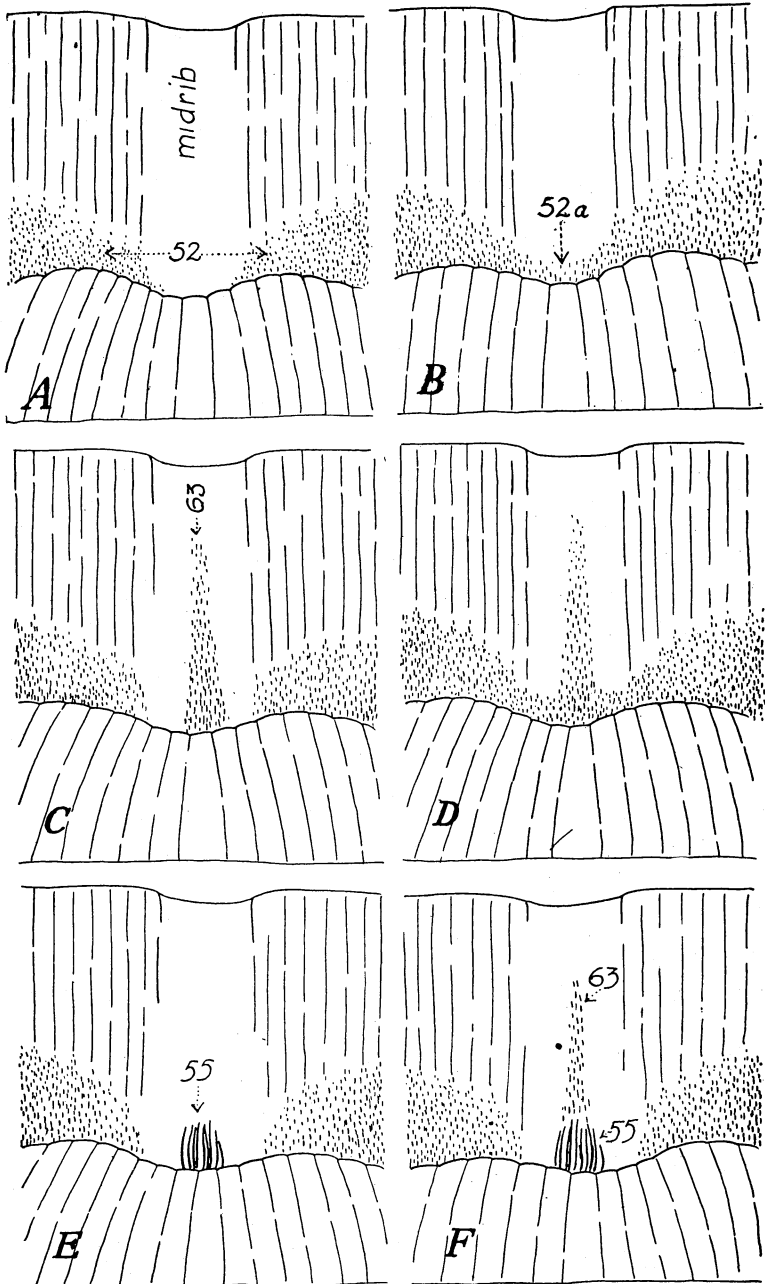


FIGURE 6.—Midrib pubescence: A, Flattened midrib region of blade joint with smooth midrib; B, group 52 of dewlap extending through midrib to form group 52a; C, group 63 implanted at base of ligule and ranging upward for a distance of one or more centimeters; D, group 63 forming an acropetal extension of group 52a; E, hair group 55; F, group 63 in continuity with group 55.

hairs (fig. 5, *E*). Because the group is usually associated with an abundant dewlap pubescence, its formation could be the result of a decrease followed by a sharp increase in length of the hairs of group 51 as they approach the midrib. Jeswiet's illustration (5) of the group suggests this possibility. The group as observed in the clones of Black Borneo, Imp. 1095, and 32-C-73, Imp. 565, of the Canal Point collection is seldom clear-cut but is transitionally connected with group 51. According to Jeswiet (6), the group is typical for Fiji canes and for seedlings with Fiji blood.

DISCUSSION AND SUMMARY

The dewlaps, or joint triangles, of sugarcane exhibit a great variety of patterns that are clone-limited. All patterns are variants of three fundamental types: Squarish, deltoid, and ligulate. The type varies somewhat within culm limits and may show a definite asymmetry near the top of the culm.

To be acceptable for taxonomic use, a character should be constant, easily seen, well defined, and stable. The dewlap pattern approaches these specifications. The narrow descending-deltoid pattern (fig. 2, *U*) is characteristic of many clones of *Saccharum spontaneum* and *S. barberi*. It is seldom found among noble canes, although the dewlaps of Co. 281 and 28 N. G. 213, while larger, are of similar design. The tall and short squarish-subcrenate dewlap of 14 N. G. 124 and Black Manila (fig. 2, *C*) is typical enough to be of major diagnostic value.

Color differences noticeable in young dewlaps tend to disappear because accumulating wax deposits discolor them as they age, changing the juvenile color to light or dark olive.

The diagnostic value of the dewlap pattern has been neglected by sugarcane taxonomists, but the dewlap pubescence has highlighted clonal descriptions since Jeswiet's recognition of the importance of this character. The pubescence varies qualitatively and in degree. Of special value are hair groups 58a of the dorsal surface and 55 of the midrib. Group 51 is variable, but stable within clone limits. Its occasional absence or weak development in clones of *S. sinense*, *S. barberi*, and the Hawaiian originals tends to separate these clones from those of other taxonomic groups.

In varieties where the hairs of group 51 form a prominent corner tuft and extend as a narrow file toward the midrib, little additional diagnostic evidence is needed to place them as a major group in a taxonomic key.

Sugarcane clones generally can be separated into two groups, depending on whether the midrib above the ligule is smooth or hairy. In the group with hairy midribs a further division is achieved by singling out clones whose pubescence is the result of an extension of the dewlap hairs, notably those of group 52, from clones with discrete midrib groups. Of these, group 55 has the greatest diagnostic value. Some of the rarer types of dewlap pubescence, groups 65 and 55, are usually found in juxtaposition with similar groups on the dorsal surface of the ligule.

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