

Morphological Characters of Some Exotic Sugarcane Varieties

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ABSTRACT

Five exotic varieties of sugarcane PS 80-1424, PS 81-362, PS 86-10029, PSGM 80-5052, and PSBM 90-44 were planted at Bangladesh Sugarcane Research Institute's experimental farm during 2003-2004 to study their morphological characters. All the varieties are greatly varied in different characters. These varieties also differed in stool, leaf blade, auricle, dewlap, ligules, stalk, bud characters and lodging tendency. Stalk height, length, number of internodes were different from each other but internodes shape and its color were more or less in similar. Stool characters were more or less in similar among the varieties. Leaf blade colour was in two types: green and deep green and its erectness had in different nature. Outer auricle shape was more or less same but inner auricle shape was greatly varied. There also had different types of ligules. Bud shape also differed, bud germ pore position most of the varieties were in apical. All the varieties had showed non-lodging tendency.

Key words: Sugarcane, varieties, morphological character and description.

INTRODUCTION

Sugarcane variety development in Bangladesh is dependent on the fuzz and imported varieties from cane breeding stations of abroad. Almost all the commercial varieties of sugarcane, presently grown in the country mainly selection from seedlings raised from the fuzz. Sugarcane cultivars being grown at present many directorates with the passage of time and therefore, it is imperative to select new varieties with high yielding potential. The use of exotic germplasm for the improvement of sugarcane is an excellent example in genetic improvement to economically important crop series (Martin, 1996). Barber (1915) first developed a system of scientific description of sugarcane. Morphological description Artschwager (1940, 1948, and 1951) and Barber (1919) are followed worldwide to describe various parts of different sugarcane varieties. Different sugarcane varieties generally resemble each other in their appearance, but actually each variety has different morphological characters. The characters those are generally influenced by environmental factors are usually quantitative characters as size and number etc. These characters are not as valuable as identifying a variety as are stable characters, like shape of vegetative organs (Artschwager, 1948), shape and arrangement of various floret parts (Grassl, 1956). Many attempts have been made to define the morphological and agricultural characteristics for identification of different sugarcane varieties (Cowgill, 1917). These characteristics are size, number and colour of stalks, bud, node and nodal characteristics, ivory markings, splits, bud grove, leaf characteristics, adult root system and underground branching. Some of these characteristics as shape of the cane is major constrain in mechanization and in some of the crop management practices. Small round buds, straight cane stalk, lesser leaves with erect lamina, lesser spreading range smaller blade joint are the qualities which make a variety the most suitable for mechanical cultivation and post harvest handling (Farooq, 1989)

MATERIALS AND METHODS

Different sugarcane varieties generally resemble each other in their appearance but they are morphologically different. Some of the characters like colour of the stalk, size and number of stalks are influence by the environmental factors. Other characters, like shape of the vegetative organs, shape and arrangement of floret parts, are stable characters and helpful in identifying various cane varieties (Figs. 1, 2, 3, 3a, 4, 5, 5a, 6, 6a).

Sugarcane varieties for the present studies were planted at experimental farm at Bangladesh Sugarcane Research Institute, Ishurdi, Pabna during the crop season 2003-2004. The settlings were transplanted in the month of November, 2003 and was harvested during December, 2004. Five exotic varieties of sugarcane imported from Indonesia such as: PS 80-1424, PS 81-362, PS 86-10029, PSGM 80-5052, and PSBM 90-44 were transplanted in an 18m square plot followed by Randomized Complete Block Design with three replications. Morphological characters of the varieties were studied when the crop was at 7-8 month and 10-12 month after planting. Stalks from the center of each plot were taken for this purpose. Those stalks were taken for morphological character determination, those were not exposed to the sun. Morphological description of Artschwager (1940) and Barber (1919) were followed to various parts of all the varieties included under study.

Following morphological characters were determined for each variety.

Stalk: Various morphological characters of the stalks like: waxiness, colour of the exposed and unexposed internode, stripes of cane, splits/growth cracks, corky cracks, corky patch was recorded from stalks selected from the middle of the field those were not exposed in the sun. Internode shape, alignment, node swelling, growth ring width, rows of root primordia, leaf scar prominence, root band shape were also determined at 7-8 month after planting. Those characters were noted from the middle portion the stalk i.e. from the top most joint whose leaf was dried. Solidness, internode cross section shape, colour, brix and pole per cent were recorded at 10-12 month after planting (Table 1a). Waxiness of the first exposed internode from the top was recorded. Colour of the exposed internode observed from the first exposed internode of the top at 8-10 am and 3-5 pm on a sunny day. Colour of the unexposed internode also was observed from the last unexposed internode of the top at 8-10 am and 3-5 pm on a sunny day. Stripes on cane stalk were noted from the first exposed internode of the top. Growth ring and root band shape was observed from the node bellow the first exposed internode of the top. Leaf scar prominence was observed from the first exposed internode of the top. Plant height recorded from the base to the tip of the longest leaf at harvest from 10 randomly selected plant. Stalk height was taken from the base to the top visible dewlap at harvest. Number of internode was taken from the basal internode to the top visible dewlap. Internode length was taken from mean of 3 internodes and which were classified as: basal-third visible internode from the base; middle-longest internode; top-first internode bellow the top visible dewlap. Average internode diameter was taken at the middle of these internode at harvest; basal-third visible internode from the base; middle-longest internode; top-first internode bellow the top visible dewlap. Solidness was taken from the third internode from the base.

Stool: Plant habit, tillering habit, tillering density, tops, leaf carriage and trashiness were noted. Tillering density classified as follows: - Poor: 1-2 tillers per stool, Light: 3-5 tillers per stool, Intermediate: 5-8 tillers per stool and profuse: > 8 tillers per stool.

Leaf blade: Taken at the fourth leaf from the first open leaf. Leaf blade colour, leaf blade texture, erectness, length, width, leaf margin pubescence, midrib colour and presence of genetic freckles was noted.

Leaf sheath: Waxiness, primary colour, secondary colour, present of preckles / trichomes (hair group 57) prickle / trichome quality and persistence of preckles / trichomes were noted. Leaf sheath was taken from the first exposed non-dry leaf.

Auricle: Observed the first exposed auricle from the top.

Dewlap: Taken at the first visible outer dewlap from the top.

Ligule: Observed at the first exposed leaf sheath from the top.

Bud: Taken at the node bellow the first exposed internode from the top.

Lodging tendency: Recorded at the time of harvest lodging tendency of the stalk was recorded.

RESULTS AND DISCUSSION

Morphological characters of cane stalk: The waxiness of all the varieties were light throughout the internode (Table 1). Colour of the exposed and unexposed internode of the varieties PS 86-10029, PSGM 80-5052 and PSBM 90-44 were greenish and the varieties of PS 80-1424, PS 81-362, were redish. The stripes of cane were present in the varieties PS 86-10029, PSGM 80-5052 and PSBM 90-44 and were absent in the varieties PS 80-1424 and PS 81-362. Splits of cane were absent in the varieties PS 80-1424, PS 81-362 and PSBM 90-44 and were present in PS 86-10029 and PSGM 80-5052. A corky crack and corky patch was absent in PS 80-1424, PS 81-362, PSGM 80-5052 and was present in PSBM 90-44. But in the variety PS 86-10029, corky cracks were present and corky patch was absent. The internode shape of all the varieties were cylindrical. Most of the varieties, the alignment was straight except PSGM 80-5052 which was zigzag. Node was not swollen. Growth ring width was narrow except the variety PS 86-10029 which was broad. There were found different rows of root primordia among the varieties as one row, two rows and three rows. Leaf scar was prominent and the root band shape were straight among the varieties. The highest plant height was found in PS 81-362 (405.00 cm) and the lowest was in PSBM 90-44 (278.00 cm) (Table 1a). The stalk length among the varieties ranges from 158.20 to 260.00 cm. The number and length of internodes varied among the varieties and its diameter ranges from 1.97 to 2.03 cm. The solidness of the stalk among the varieties, PSBM 90-44 was found solid, PS 81-362 hollow and PS 80-1424, PS 86-10029 and PSGM 80-5052 were found pithy. Internode cross section shape was round and the colour of the cross section was whitish.

Stool characters: The varieties PS 80-1424, PS 86-10029 and PSBM 90-44 were erect plant habit in nature (Table 2). Tillering habit of all the varieties were compact. There were found two types of tillering density, which were light and intermediate. The varieties PS 80-1424 and PS 81-362 were light and varieties PS 86-10029, PSGM 80-5052 and PSBM 90-44 were intermediate tillering density. Tops of all the varieties were light and the leaf carriage was open and found intermediate trassiness.

Leaf blade characters: Most of the varieties, the leaf blade colour was green and the variety PS 80-1424 was found in deep green (Table 3). All the varieties, the leaf blade texture was smooth. There were different types of erectness. The variety PS 80-1424 had bent near tip and PSGM 80-5052, PSBM 90-44 was erect to tip. The two of the varieties, PS 81-362 had curved near tip and PS 86-10029 had curved near middle. The length of leaf blade was varied among the varieties and ranges from 123.2 to 139.4 cm. The highest width of leaf blade was found PSBM 90-44 (5.20 cm) and the lowest was PSGM 80-5052 (4.16 cm). Leaf margin pubescence of all the varieties were present, mid rib colour was whitish and genetic freckles was absent.

Leaf sheath characters: All the varieties, waxiness of the leaf sheath was light (Table 4). The primary and secondary colour of the leaf sheath was greenish except the variety PS 80-1424, which was brownish in secondary colour. Most of the varieties, the prickles were absent except the variety PS 86-10029, was found few prickles. The quality of prickles of PS 86-10029 was soft and it was deciduous in nature.

Auricle characters: The outer auricle shape was found sloping transitional in the varieties PS 80-1424, PS 81-362 and PS 86-10029 and the varieties PSGM 80-5052 and PSBM 90-44 were found in straight transitional (Table 5). There were found various types of inner auricle shape. The varieties of PS 86-10029 and PSGM 80-5052 had long lanceolate, PS 80-1424 had deltoid, PS 81-362 had ascending transitional of inner auricle shape.

Dewlap characters: The dewlap of all the varieties had light waxiness (Table 6). The primary colour of the dewlap was greenish in PS 81-362, PS 86-10029 and PSBM 90-44, and the varieties PS 80-1424 and PSGM 80-5052 had radish colour dewlap. The secondary colour of the dewlap was greenish in PS 81-362 and PSBM 90-44, and the varieties of PS 80-1424, PS 86-10029 and PSGM 80-5052 had brownish colour dewlap. The shape of the dewlap of all the varieties was triangular except the variety PSBM 90-44, which was squarish. Dewlap margin undulation and hairs were present in all the varieties.

Ligule characters: The shape of ligule had crescent with lozenge in PS 81-362 and PS 86-10029 and the variety PSBM 90-44 had crescent with narrow lozenge shape ligule (Table 7). The ligule shape had broad crescent in the varieties PS 80-1424 and PSGM 80-5052. The hairs of the ligule were not prominent.

Bud characters: The bud shape was roundish with wings in PS 81-362, PS 86-10029 and PSBM 90-44 (Table 8). The varieties of PS 80-1424 and PSGM 80-5052 had pentagonal bud shaped. Prominence of bud was bulging in PS 80-1424, PS 81-362, PS 86-10029 and PSGM 80-5052 and the prominence of bud was flat in PSBM 90-44. Among the varieties, the bud length ranges from 7.4 to 9.8 mm and width ranges from 5.2 to 8.6 mm. All the varieties, bud germ pore position were apical except PSBM 90-44, was sub apical. The bud grove expression of the variety PS 80-1424 was medium and the others were absent. Bud hair was not prominent. The bud tip position of the varieties PS 80-1424 and PS 81-362 were below growth ring and the varieties PS 86-10029, PSGM 80-5052 and PSBM 90-44 were on growth ring. The bud base position of the variety PS 80-1424 was above leaf scar and the others were at leaf scar.

Lodging tendency: The tendency of all the varieties were non-lodging in nature (Table 9).

There were certain characters those are influenced by the environmental factors and the management of crop. These characters were as size (height and thickness) of the stalk and colour of the leaf blade. Others characters were stable characters those were not influenced by the environmental or management factors. Those were shape of the stalk, dewlap, bud auricle and others of these parts (Grassl, 1956). Various researchers found differences in morphological character of sugarcane varieties (Artschwager, 1940, 1948, 1951 and Baber, 1919). The characters of the varieties, which were not influenced by the environment, might be used for the identification.

Table 1. Stalks characterization of some exotic sugarcane varieties at 7-8 month after planting

Varieties	Stalk Characters													
	Waxiness	*Colour of exposed internode	*Colour of unexposed internode	Stripes of cane	Splits/ growth cracks	Corky cracks	Corky patch	Internode shape	Alignment	Node swelling	Growth ring width	No. of rows of root primordia	Leaf scar prominence	Root band shape
PS 80-1424	Light throughout internode	Radish	Radish	Absent	Absent	Absent	Absent	Cylindrical	Straight	Not swollen	Narrow	One row	Prominent	Straight
PS 81-362	Light throughout internode	Radish	Radish	Absent	Absent	Absent	Absent	Cylindrical	Straight	Not swollen	Narrow	Two rows	Prominent	Straight
PS 86-10029	Light throughout internode	Greenish	Greenish	Present	Present	Present	Absent	Cylindrical	Straight	Not swollen	Broad	Three rows	Prominent	Straight
PSGM 80-5052	Light throughout internode	Greenish	Greenish	Present	Present	Absent	Absent	Cylindrical	Zigzag	Not swollen	Narrow	Two rows	Prominent	Straight
PSBM 90-44	Light throughout internode	Greenish	Greenish	Present	Absent	Present	Present	Cylindrical	Straight	Not swollen	Narrow	One row	Prominent	Straight

*with visual grading

Table 1a. Stalks characterization of some exotic sugarcane varieties at 7-8 month after planting

Varieties	Stalk characters							
	Plant height (cm)	Stalk length (cm)	No. of internodes	Internode length (cm)	Internode diameter (cm)	Solidness	Internode cross section shape	*Internode cross section color
PS 80-1424	370.66	226.20	24.20	8.76	1.97	Pithy	Round	Whitish
PS 81-362	405.00	256.80	23.20	10.55	2.03	Hollow	Round	Whitish
PS 86-10029	399.60	260.00	23.80	10.05	2.01	Pithy	Round	Whitish
PSGM 80-5052	379.60	249.40	22.80	9.96	1.99	Pithy	Round	Whitish
PSBM 90-44	278.00	158.20	20.60	7.87	2.03	Solid	Round	Whitish

*with visual grading

Table 2. Stool characterization of some exotic sugarcane varieties at 7-8 month after planting

Varieties	Stool characters					
	Plant habit	Tillering habit	Tillering density	Tops	Leaf carriage	Trashiness
PS 80-1424	Erect	Compact	Light	Light	Open	Intermediate
PS 81-362	Intermediate	Compact	Light	Light	Open	Intermediate
PS 86-10029	Erect	Compact	Intermediate	Light	Open	Intermediate
PSGM 80-5052	Intermediate	Compact	Intermediate	Light	Open	Intermediate
PSBM 90-44	Erect	Compact	Intermediate	Light	Compact	Intermediate

Table 3. Leaf blade characterization of some exotic sugarcane varieties at 7-8 month after planting

Varieties	Leaf blade characters							
	*Colour	Leaf blade texture	Erectness	Length (cm)	Width (cm)	Leaf margin pubescence	*Midrib colour	Presence of genetic freckles
PS 80-1424	Deep green	Smooth	Bent near tip	136.4	4.48	Present	Whitish	Absent
PS 81-362	Green	Smooth	Curved near tip	139.4	4.54	Present	Whitish	Absent
PS 86-10029	Green	Smooth	Curved near middle	133.6	4.56	Present	Whitish	Absent
PSGM 80-5052	Green	Smooth	Erect to tip	130.8	4.16	Present	Whitish	Absent
PSBM 90-44	Green	Smooth	Erect to tip	123.2	5.20	Present	Whitish	Absent

*with visual grading

Table 4. Leaf blade characterization of some exotic sugarcane varieties at 7-8 month after planting

Varieties	Leaf sheath character					
	Waxiness	*Primary colour	*Secondary colour	Presence of prickles/trichomes	Prickles/trichome quality	Persistence of prickles/trichomes
PS 80-1424	Light	Greenish	Brownish	Absent	Absent	Absent
PS 81-362	Light	Greenish	Greenish	Absent	Absent	Absent
PS 86-10029	Light	Greenish	Greenish	Few	Soft	Deciduous
PSGM 80-5052	Light	Greenish	Greenish	Absent	Absent	Absent
PSBM 90-44	Light	Greenish	Greenish	Absent	Absent	Absent

*with visual grading

Table 5. Auricle characterization of some exotic sugarcane varieties at 7-8 month after planting

Varieties	Auricle Characters	
	Outer auricle shape	Inner auricle shape
PS 80-1424	Sloping transitional	Deltoid
PS 81-362	Sloping transitional	Ascending transitional
PS 86-10029	Sloping transitional	Long lanceolate
PSGM 80-5052	Straight transitional	Long lanceolate
PSBM 90-44	Straight transitional	Straight transitional

Table 6. Dewlap characterization of some exotic sugarcane varieties at 7-8 month after planting

Varieties	Dewlap Characters					
	Waxiness	*Primary color	*Secondary color	Shape	Dewlap margin undulation	Hairs (hair group 64)
PS 80-1424	Light	Radish	Brownish	Triangular	Present	Present
PS 81-362	Light	Greenish	Greenish	Triangular	Present	Present
PS 86-10029	Light	Greenish	Brownish	Triangular	Present	Present
PSGM 80-5052	Light	Radish	Brownish	Triangular	Present	Present
PSBM 90-44	Light	Greenish	Greenish	Squarish	Present	Present

*with visual grading

Table 7. Ligules characterization of some exotic sugarcane varieties at 7-8 month after planting

Varieties	Ligules Characters	
	Shape	Hairiness
PS 80-1424	Broad crescent	Not prominent
PS 81-362	Crescent with lozenge	Not prominent
PS 86-10029	Crescent with lozenge	Not prominent
PSGM 80-5052	Broad crescent	Not prominent
PSBM 90-44	Crescent with narrow lozenge	Not prominent

Table 8. Bud characterization of some exotic sugarcane varieties at 7-8 month after planting

Varieties	Bud Characters								
	Shape	Prominence	Length	Width	Bud germ pore position	Bud groove/furrow expression	Bud hair (hair group)	Bud tip position	Bud base position
PS 80-1424	Pentagonal	Bulging	9.8	8.4	Apical	Medium	Not prominent	Bellow growth ring	Above leaf scar
PS 81-362	Roundish with wings	Bulging	9.0	7.4	Apical	Absent	Not prominent	Bellow growth ring	At leaf scar
PS 86-10029	Roundish with wings	Bulging	7.4	8.6	Apical	Absent	Not prominent	On growth ring	At leaf scar
PSGM 80-5052	Pentagonal	Bulging	8.8	6.8	Apical	Absent	Not prominent	On growth ring	At leaf scar
PSBM 90-44	Roundish with wings	Flat	9.0	5.2	Sub Apical	Absent	Not prominent	On growth ring	At leaf scar

Table 9. Lodging tendency of some exotic sugarcane varieties at 7-8 month after planting

Varieties	Lodging tendency
PS 80-1424	Non-lodging
PS 81-362	Non-lodging
PS 86-10029	Non-lodging
PSGM 80-5052	Non-lodging
PSBM 90-44	Non-lodging

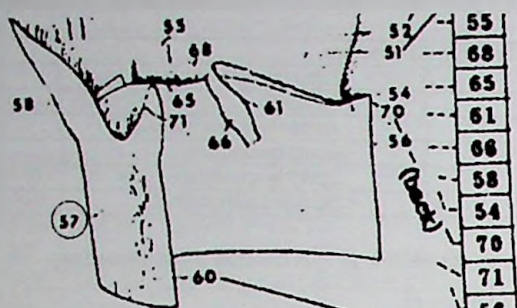


Figure 1: Leaf sheath with 57 hair group

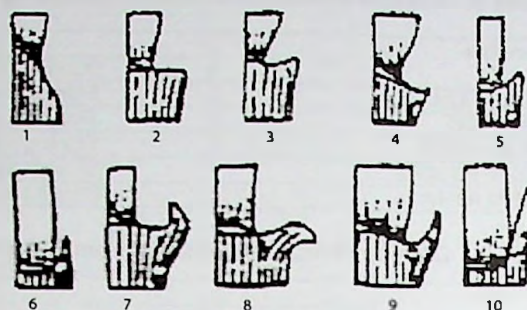


Figure 2: Types of auricle: 1, sloping transitional; 2, straight transitional; 3, ascending transitional; 4, dentoid; 5, deltoid; 6, short lanceolate; 7, unciform; 8, calcarate; 9, falcate; 10, long lanceolate

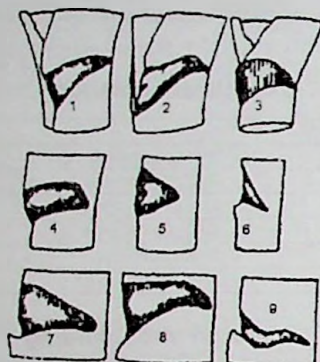


Figure 3: Types of dewlap: 1 triangular - ligulate; 2 less ligulate; 3 tall triangular; 4 squarish; 5 deltoid; 6 triangular; 7 triangular with horizontal basal margin; 8 more or less triangular; 9 typical ligulate

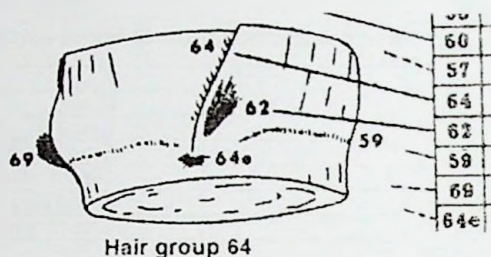


Figure 3a: Dewlap with hair group 64

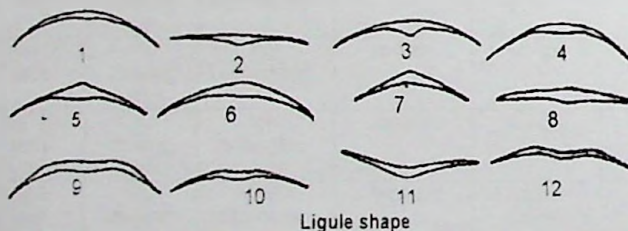
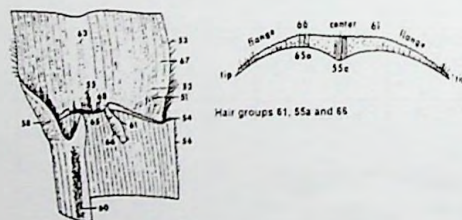


Figure 4: Types of ligule: 1 orbicular crescent; 2 flat crescent; 3 crescent with broad lozenge; 4 crescent with narrow lozenge; 5 crescent with lozenge; 6 broad crescent; 7 deltoid; 8 linear crescent; 9 broad subarcuate; 10 narrow subarcuate; 11 inverted crescent; 12 arcuate



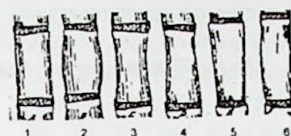
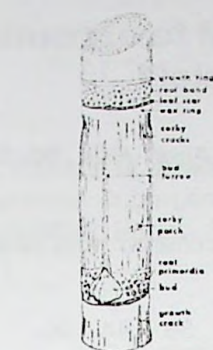


Figure 5: Node and internodes: 1 cylindrical; 2 barrel-shape; 3 bobbin- shape; 4 conoidal; 5 obconoidal; 6 curve

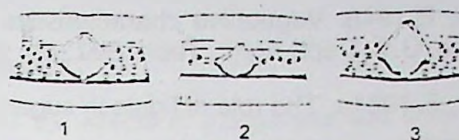


Figure 5a: Root band shape: 1 conoidal; 2 straight; 3 obconoidal

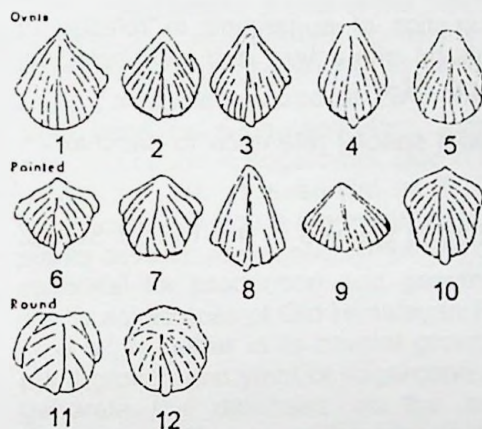


Figure 6: Different shaped bud: 1 ovate with emarginated wings; 2 ovate with secondary wings; 3 simple ovate; 4 narrow ovate; 5 ovate with wing broadening toward apex; 6 squat rhomboid; 7 pentagonal, 8 tall deltoid; 9 short deltoid; 10 squarish pentagonal with wing set high; 11 roundish with wings; 12 round with central germ pore

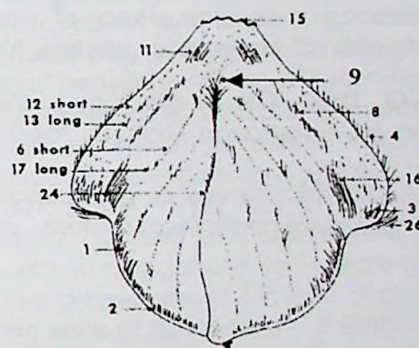


Figure 6a: Sugarcane bud

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