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SHORT COMMUNICATION

SHORT LOP-SIDED INTERNODES IN *SACCHARUM OFFICINARUM* REVISITED

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Abstract

Saccharum officinarum, more commonly referred to as noble cane, possesses attractive morphological variation in rind colour, rind stripes and cane shape. In the present study, an interesting trait of short lop-sided internodes exhibited by some of the genotypes of *S. officinarum* was examined. Six *S. officinarum* genotypes exhibited this trait in varying percentage of shoots and also in varying numbers i.e. single or groups of two or more at one point, interspersed with normal internodes. Anatomical observations revealed that the short internodes had a relatively shorter cell with meristematic activity as opposed to the longer thick walled mature cells in normal internodes. This trait may have been lost due to selective planting of canes with normal internodes. Thus, selective planting may need to be followed to maintain or prevent short internode trait in the germplasm accessions.

Saccharum officinarum, the noble cane, displays considerable variation with respect to morphological traits, such as internode colour, stripes, size and shape, besides yield and quality traits. In a sugarcane stalk, internodes are short and thin at the base, increase gradually in length and girth as the cane grows and become short at maturity (Moore 1987). The length and thickness of the internodes are greatly influenced by environmental factors (Artschwager and Brandes 1958), particularly insufficient moisture, low temperature, damage to leaf canopy, etc. On the contrary, excess moisture stress also reduces the length of the internodes in all the shoots of a susceptible clone (Gomathi et al. 2015). Shorter internodes often occur due to borer incidence at the node immediately below it with subsequent bud elongation. Ethirajan (1960) reported the presence of short lop-sided internodes for the first time in the *S. officinarum* clone 51 NG 121 in groups of two at two or three places interspersed with normal internodes along the cane stalk. In the present study, we examined the accessions of *S. officinarum* for short lop-sided internodes and recurrence of the trait.

We examined all the 757 *S. officinarum* clones from the world collection of sugarcane germplasm maintained at the ICAR-Sugarcane Breeding Institute Research Centre, Kannur, Kerala, India, for short lop-sided internodes. Six clones, namely 28 NG 2, 51 NG 59, 51 NG 122, 51 NG 124, 51 NG 125 and 57 NG 212 had such short lop-sided internodes at intervals in a cane. Short internodes occurred singly or in groups of two, three or more but predominantly as single internodes (Fig. 1). Even within a clone, all the canes did not show short lop-sided internodes and the percentage of such shoots varied with the genotype (Table 1). However, short lop-sided internodes were not observed in the clone 51 NG 121 as reported earlier by Ethirajan (1960).

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Table 1. NMC, HR brix, length and diameter of internodes of canes with normal and short lop-sided internodes in six *Saccharum officinarum* clones

Clone	Shoots /plot	% of shoots with short internodes	Normal internode			Short lop-sided internode			
			HR Brix (%)	Length (cm)	Dia-meter (cm)	HR Brix (%)	Length at longest side (cm)	Length at shortest side (cm)	Dia-meter (cm)
28 NG 2	13	100.0	13.7	10.2	2.8	12.7	2.6	2.0	3.2
51 NG 59	21	100.0	14.3	9.9	2.3	13.5	2.0	1.4	3.0
51 NG 122	10	80.0	16.1	11.4	2.0	14.6	2.3	1.7	2.2
51 NG 124	18	94.4	19.8	19.0	2.1	19.0	2.4	1.8	1.9
51 NG 125	13	61.5	18.3	18.0	2.4	18.0	1.5	1.0	3.2
57 NG 212	22	100.0	16.2	11.7	2.6	13.5	1.9	1.3	2.7

To understand the anatomical differences between the long and short internodes, hand sections of internodes were prepared with a razor blade. The sections were stained with 1% aqueous solution of safranin and observed under Zeiss (Primostar) Microscope and photographed using Canon EOS 1100D camera. The measurements were taken from 20 cortex cells at random from three slides for each accession using ocular micrometer. The Hand refractometer brix was recorded in two replications from adjacent short and longer internodes from three canes each and Student's test was conducted using SPSS software package. Anatomical studies revealed that there were no differences in the cross-sectional features of normal and short lop-sided internodes except for the more deeply stained sclerenchymatous cells around the vascular bundles in short lop-sided internodes (Fig. 2). Longitudinal section showed that the length of cells in the short lopsided internodes was short (150 ± 15 µm) with L/B ratio of 1:0.9 compared to normal internodes which had elongated cells (384 ± 30 µm) with L/B ratio of 5:1 (Fig. 2E & F). The HR brix recorded in the short lop-sided and normal internodes did not show any significant difference statistically (t=0.821; P=0.579) when all the accessions were taken together indicating that sucrose accumulation was not affected in short lop-sided internodes though they appear to be meristematic in the cross section.

To study the stability of this specific trait during continuous vegetative propagation, single budded setts from the genotype 51 NG 125, which showed the least percentage of shoots with short lop-sided internodes (61.5%), were selected. Five single budded setts were planted in pots in three categories, namely short lop-sided internodes, long internodes adjacent to the short internode and internodes from cane totally free of short lop-sided internodes. The canes formed from the first two categories were similar to the parent cane morphologically as they showed short lop-sided internodes intermittently. Similarly, the buds germinated from the cane with all normal

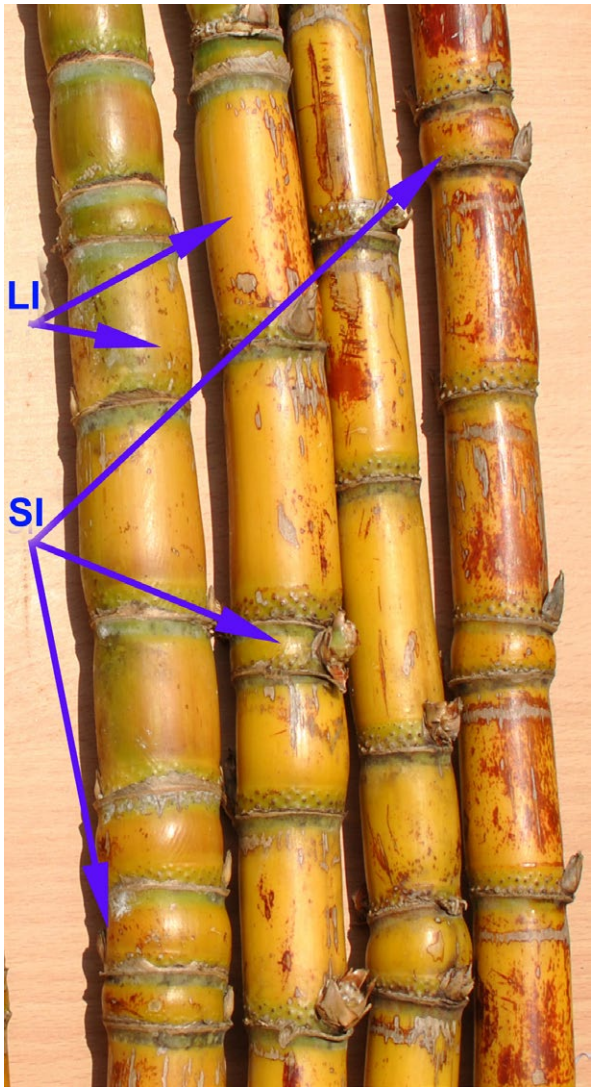

Fig. 1. Canes with short lop-sided internodes in 51 NG 125: LI – long normal internodes; SI - short lop-sided internodes

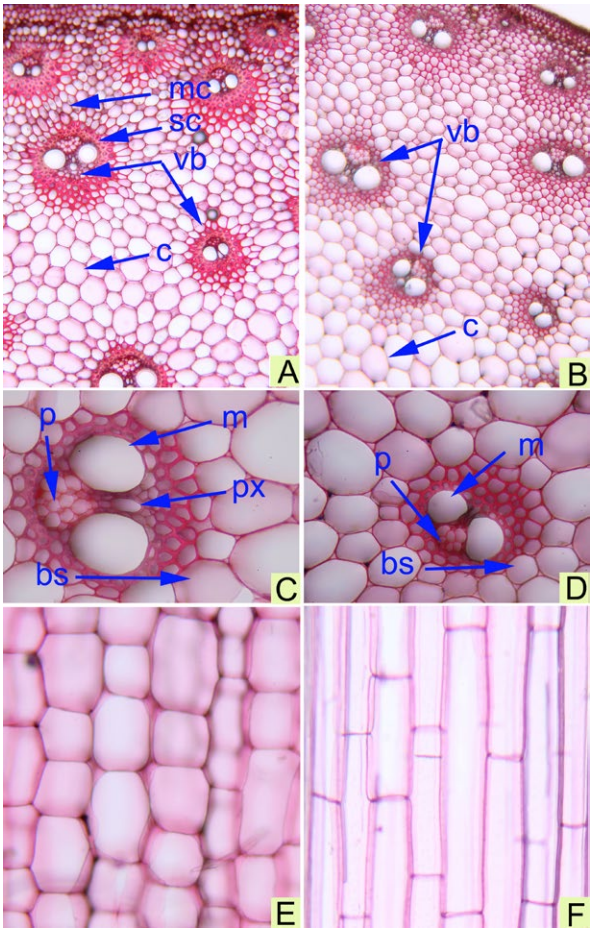

Fig. 2. Cross-section (CS) and longitudinal section (LS) of internodes in 51 NG 125: CS of short lop-sided (A&C) and normal (B & D) internodes; LS of short lopsided (E) and normal (F) internodes showing cortex cells; mc - meristematic cells, sc - sclerenchyma, vb - vascular bundle, c - cortex, bs - bundle sheath, p - phloem, px - protoxylem, m - metaxylem

internodes gave rise to normal cane without short lop-sided internodes. It is assumed that the clone 51 NG 121 lost this specific trait over a period of time, apparently due to deliberate use of stem cuttings from canes with normal internodes.

Premachandran and Tripathi (1999) reported a natural mutant of *S. officinarum* clone, 51 NG 131. This clone possesses the morphological feature of tumescent internodes with rind stripes. In the mutant, the tumescent internode changed to conoidal internode in conjunction with elongated non-striped internodes. The authors inferred that the gene controlling tumescent internode might be linked to the anthocyanin gene which was modified due to transposable elements. The short lop-sided internode trait may probably be under the control of transposons as in the case of tumescent internode in 51 NG 131. However, elaborate studies are needed to understand the mechanism governing the trait. Reversion from striped rind to stripeless

condition is common in *S. officinarum* clones and maintenance of striped trait needs selection of striped canes for subsequent multiplication and maintenance. Since this short lop-sided internode is a unique feature of the clones listed above, it needs to be preserved to confirm the identity and maintain the uniqueness of the clones. To retain this trait in the clones, similar voluntary selection of canes with short internodes has to be made while re-planting.

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