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MORPHOLOGICAL VARIATION IN THICK AND THIN CANES STALING IN DIFFERENT PORTIONS OF CANE STALK

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Abstract

Quality and recovery are the two important concerned aspects for sugar millers. Both of these depend on the supply of canes to the mills. Supply of stale canes, irrespective whether thick or thin canes, to sugar mills are a common phenomenon observed leading to loss in recovery. Thus, this study was conducted to observe the morphological staling pattern in thick and thin canes of an early ripening variety of sugarcane, CoPk 05191. Thick and thin canes (five canes each) were selected on the basis of thickness and to understand the staling pattern visually, internode from top, middle and bottom was marked in thin and thick canes for assessment. Cane width of each internode of thin and thick canes was also recorded by vernier caliper. Study revealed that the top portion shows the first symptom of visual staling followed by middle and bottom portions, irrespective of thickness. Study also showed that thin canes are more prone to early staling. Furthermore, distorted shape (rectangular in shape) of middle internodes was also observed only in thick canes. Loss in cane weight was relatively higher in thick canes than in thin canes. This study helps in enhancing our knowledge in understanding the staling pattern of thick and thin canes of same variety.

Key words : Staling, sugarcane, thick canes, thin canes, weight, recovery.

Introduction

Sugarcane is the main raw material for the production of sugar. It is grown in about 115 countries in the world covering an area of 126 million ha. Indian sugar industry is the source of income for about 6.0 million people who cultivate canes. In India, this crop covers an area of five million ha with an average productivity of approx. 71 t/ha wherein the contribution by tropical states was highest in comparison to the sub tropical part (IISR Vision, 2050). In the present scenario, sugar has become an essential product in human's diet and even does not lack behind for trade purposes (Saxena *et al*., 2010). As per the vision 2050, the consumption rate per capita of this product will further increase up to 35 kgs including the consumption of white sugar and jaggery in years to come. It is well known that sugarcane crop starts losing its sucrose content as soon as it is detached from soil and after few days of harvest, sucrose content has been highly affected due to several reasons (Saxena *et al*., 2010; Misra *et al*., 2016, 2017).

Staling is a common process which occurs immediately after cane is harvested (Misra *et al*., 2016; 2016a, 2017). A stale cane is considered to be the one that has lost recoverable sugars after harvest, may be due to the difference in time interval between cutting and crushing (Solomon, 2009) which contributes to increase in post-harvest sucrose losses. Post-harvest sucrose loss is a crucial trouble for millers and if under such a situation, supply of stale canes to the mills has been received, this problem further accentuates. It is well known that the cane supplied in the mills are of variable types such as different varieties, damaged/diseased/ calamity affected canes along with healthy canes, however, frequency of occurrence of stale canes in mills for crushing is relatively higher in comparison to fresh canes. Staling in this regard further contributes to poor juice quality leading to low sugar recovery (Misra *et al*.,

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2016b; Mehrotra, 2015). Supply of stale canes have been reported to be harmful both for growers (in achieving lower cane price from buyers) and for millers as it causes increase in cost of processing as well as difficulties in its processing like reduce rate of grinding, low purity of juice, poor clarification, increase in crystallization rate, etc., into sugar. In accordance to the sugar obtained from these canes, high content of dextran has also been reported. Formation of polysaacharide is also one of the problems attained in processing such canes leading to relatively higher losses in sugar recovery. Measures have been suggested and adopted for preventing the loss in recoverable sugar by supplying as fresh cane as possible to the mills and even studies are being performed on minimizing the post harvest losses but still large amount of stale canes are being supplied in the sugar mills even today. It is well known that staling in sugarcane causes shrinkage in sugarcane stalk but to the best of the ability, there have been no such study on staling pattern of thick and thin canes. Thus, this study focuses on the morphological staling pattern in thick and thin canes of sugarcane.

Materials and Methods

The study has been conducted at ICAR-Indian Institute of sugarcane Research, Lucknow (U.P.), India. Thick and thin canes of variety CoPk 05191 were selected on the basis of the stalk diameter. To assess the morphological staling pattern in sugarcane, the harvested cane stalks were left in fields. Cane weight of each sugarcane stalk was recorded after every 2nd day until the cane weight of the stalk becomes constant. Single internodes were selected and marked in both thick and thin canes from top, bottom and middle portion of the stalks for staling pattern observation of different portions. Cane diameter of each stalk was also recorded weekly by vernier caliper.

Results and Discussion

Staling pattern in thick canes

In thick canes, after a week after harvest, top portion showed first signs of staling with the appearance of wrinkles in form of shrinkage (figs. 1a, 1b). After two weeks of harvest, the middle portion started staling in the same manner as that of top portion (figs. 1a, 1c). It was observed that the appearance of wrinkles in bottom portion appeared in the third week after cane harvest (figs. 1a, 1d). This showed that the top portion internode stale first followed by middle and bottom portion of the cane stalk. This may be due to low maturity status of the top portion and presence of high amount of reducing sugars in this portion in compared to other portions.

Table 1 : Alteration in cane width in thick canes due to staling.

Internode number (Bottom to Top)	Width after 18 days of harvest	
1	2.45	2.45
2	2.47	2.47
3	2.47	2.47
4	2.44	2.44
5	2.36	2.36
6	2.59	2.59
7	2.56	2.56
8	2.53	2.53
9	2.93	2.93
10	2.93	2.93
11	**2.93**	**2.61**
12	**2.93**	**2.77**
13	2.85	2.85
14	2.83	2.83
15	2.83	2.83
16	2.83	2.83
17	2.83	2.83
18	3.33	3.33
19	2.93	2.93
20	2.82	2.82
21	2.94	2.94
22	**2.94**	**3.22**
23	2.94	2.94
24	2.98	2.98
25	2.82	2.82
26	3.33	3.33
27	3.33	3.33
28	2.72	2.72
29	2.72	2.72
30	2.66	2.66
31	2.44	2.44
32	2.15	2.15

However, a unique morphological alteration was seen in thick canes during increase in staling period. It was observed that after eighteen days of harvest, some of the internodes of either middle or bottom portion of the thick canes started distorting its cylindrical shape to rectangular shape (figs. 2 and 3). Further verification of alteration in cane width was confirmed by measurement of width of distorted internodes (table 1). Table 1 showed that in middle portion of the cane stalk (11, 12 and 22 internode) possess variation in width of thick canes. This may be due to more sucrose content in thick canes and due to staling, the shape of the stalk gets distorted.

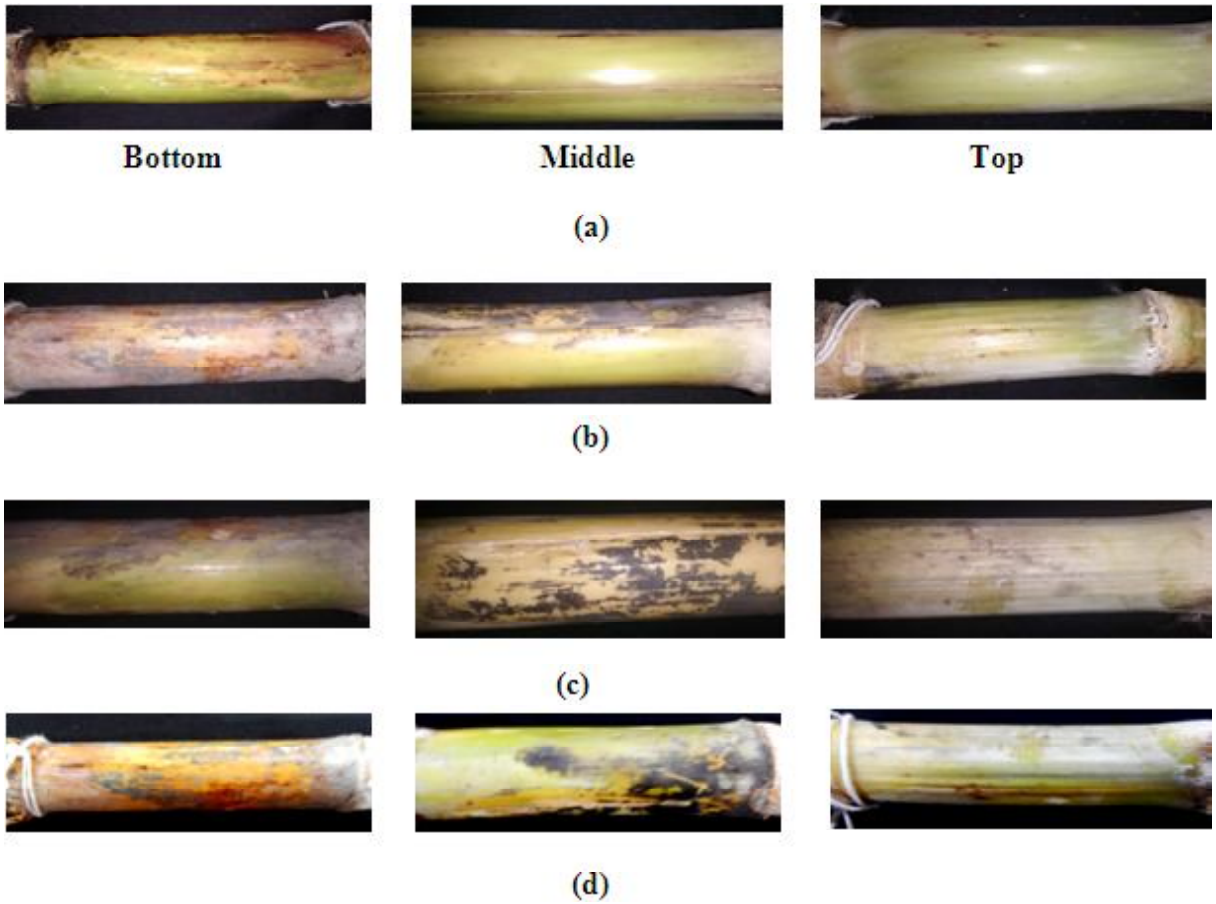

Fig. 1 : a. Freshly harvested thick canes internode showing top, middle and bottom portion. **b.** After a week after harvest, top portion showed staling. **c.** After two weeks after harvest, Middle portion showed staling. **d.** After third weeks after harvest, bottom portion showed staling.

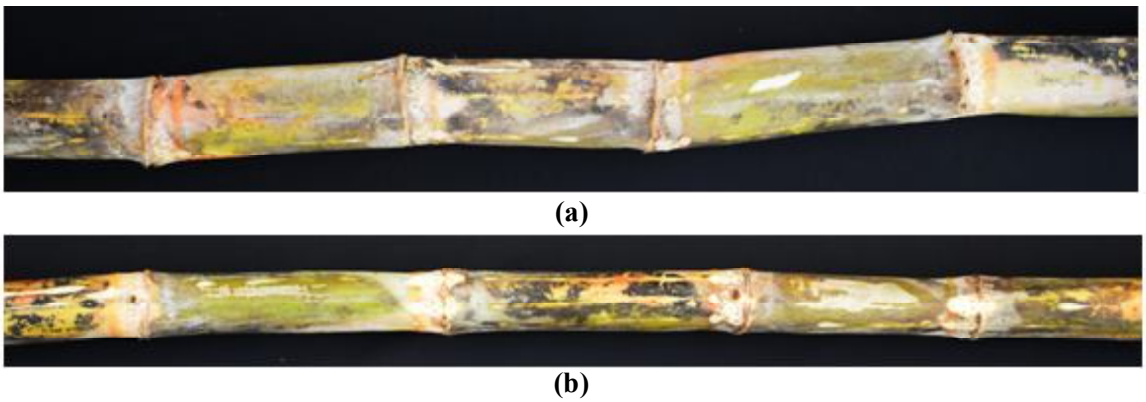

Fig. 2 : Morphological alteration in thick canes due to staling.

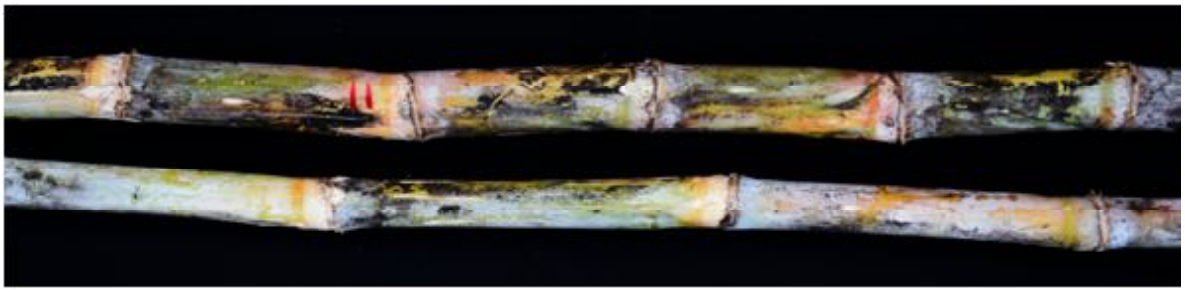

Fig. 3 : Comparison of shape of internodes in stale cane with freshly harvested thick canes.

Staling pattern in thin canes

It was observed that the top/upper portion showed the first staling symptoms in form of slight wrinkles after four days after harvest as a mark of appearance of shrinkage in thin canes (figs. 2a, 2b). Thereafter, the middle portion showed the staling symptoms after ten days of harvest (figs. 2a, 2c) followed by staling in bottom portion after eighteen days of cane harvest (figs. 1a, 1d). The thin canes followed the same pattern of staling in all three portions as that of thick canes, however, the thin canes showed early staling as compared to thick canes (in top, middle and bottom portion of cane stalk). This implies that thin canes are more prone to early staling.

Cane weight variation in thin and thick canes over the time period

A gradual decrease in cane weight in thin and thick canes was observed after harvest. Loss in cane weight is a major problem for cane growers as loss in cane weight causes decrease in price paid to them (Solomon, 2000; Misra *et al*., 2016). The problem of lowering in weight of cane due to process of staling after harvest depends on the type of variety, whether the cane is damaged or diseased and also on weather conditions (Solomon, 2009). Results showed that after one month of harvest, there was decrease in cane weight of approx. 355 g in thin canes while in thick canes, this loss was relatively more (approx. 514 gm). Further storing of thin and thick canes for an another month showed further decrease in cane weight by approx. 620 gm in thin canes, however, there was loss of approx. 1.174 gm further in thick canes. This implies that in the second month after harvest, thin canes deteriorate more than the thick canes. It is interesting to see that after two months and twenty days after harvest, there was no loss in cane weight in both sorts of canes. Result showed that there was a total loss of approx. 640 gm in thin canes and approx. 1.380 gm in thick canes, indicating more loss in cane weight in thick canes in comparison to thin canes due to more amount of sucrose content in former than in latter.

Conclusion

Sugar quality and its recovery rate are the most important parameters for sugar millers. Supply of staled canes lowers the quality and recovery of sugar mills. The study showed that there is a variation in staling pattern of thin and thick canes where thin canes are more prone to early staling. Furthermore, staling in thick canes had relatively higher cane weight loss than thin canes. There is a need to avoid supply of thin canes to mills at a farther distance as they are more prone to early staling. As earlier studies have suggested, supply of as fresh a cane should be done so as to achieve high sugar recovery and huge profits. There is a need for further study on staling pattern of different varieties as staling in sugarcane depends on varietal type.

Acknowledgments

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