SHORT NON-REFEREED PAPER

ATTEMPTS TO DETECT THE DEGREE OF DETERIORATION IN COMMERCIAL SUGARCANE: LESSONS LEARNT

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Abstract

Delays between harvesting and milling continue to be a notable indicator of cane supply chain inefficiency in South Africa. An empirical investigation of cane deterioration in this context was conducted. Two cane storage trials of nine days each were performed using varieties N12 and N31 stored under ambient conditions. Parameters monitored were respiration, D-lactate production, total bacterial counts and Pol % Fibre. Parameters were measured at the bottom, middle and top sections of the stalks to evaluate the effect of stalk section on parameter changes. The stalk sections significantly affected the parameters, with the top and bottom sections showing greater bacterial proliferation, respiration rates and D-lactate production than the middle section in Trial 1 ($P<0.001$). A significant difference in activity was observed between trials, with Trial 2 showing less activity and less variation in stalk section and between varieties. In Trial 1, a significant declining trend was noted for Pol % Fibre in the top section ($P<0.05$). The effect of greater respiration in the cut ends in Trial 1 was noted in significantly reduced Pol % Fibre in these cut ends during the storage time. Environmental conditions were found to be the major factor influencing quality during the storage period. The top (less mature) section of the cane stalks showed more changes after harvest and might be more susceptible to deterioration. Burnt cane showed a reduced influence of stalk section in changes observed. This information adds to existing knowledge and may prove valuable to growers, for example in deciding whether to harvest immature stalks or ripen to enhance maturity, and in deciding on harvest techniques such as burning or delivering green cane.

Keywords: sugarcane quality, sugarcane supply chain, post-harvest deterioration, harvest to crush delay

Introduction

In South Africa, sugarcane deterioration has been noted as a problem that impacts on efficient sugar recovery in the factory, as well as overall sugar quality (Eggleston and Harper, 2006; Walford and Nel, 2010). Over the years researchers have been trying to establish a measure of deterioration severity (e.g. Wood, 1976; Lyne and Meyer, 2005; Petit *et al.*, 2009). The absence of a cane deterioration parameter in the payment formula as well as the complex nature of cane quality behaviour after harvest has resulted in sub-optimal post-harvest practices (Lyne and Meyer, 2005; Martin, 2008). The aim of this study was to investigate the change in cane quality during burn/harvest to crush delays (BHTCD), by monitoring quality parameters in different stalk sections during storage.

Methods

The study involved the generation and statistical analysis of laboratory data. In both trials commercially mature cane (N12 and N31) was harvested randomly from different stools in a commercial plot and topped at the natural breaking point (*cf.* van Dillewijn, 1952). Unburnt cane was harvested in Trial 1, whereas burnt cane was harvested in Trial 2. The cane stalks were stored for nine days in ambient conditions. Cane sampling involved five replicates of each variety, each replicate constituting 10 cm of the bottom, middle and top portions of the stalk. Sampling was performed on days one, three, seven and nine of storage.

The respiration rate was measured according to the method of Saltveit (2004) using an infra-red gas analyser (IRGA) respirometer (EGM-4, PP Systems®, Massachusetts, USA). D-lactate concentration (indicating lactic acid) was determined according to the method described by Martin (2008) using a bioanalysis kit (R-Biopharm, Roche, Manheim). Total bacterial counts were performed on Tryptone Soy Agar as per Margesin *et al.* (2011). Industry cane quality parameters were measured at the South African Sugarcane Research Institute (SASRI) laboratories using direct analysis of cane (DAC) techniques (*cf.* Schoonees-Muir *et al.*, 2009).

Results and Discussion

Air temperature was not significantly different between Trials 1 and 2; the major difference in ambient conditions was noted in higher relative humidity and more rainfall in Trial 1. Table 1 shows a significant difference in the effect of stalk portion. The difference between varieties was minimal. The highest bacterial infection, lactic acid concentration and respiration rates (Trial 1) were in the cut ends. Furthermore, in Trial 1 the top (less mature) cane portion showed higher respiration and a faster decline in Pol % Fibre (Figure 1) during storage. In addition, Figure 1 shows no significant change in Pol % Fibre in Trial 2. This can be correlated to the results shown in Table I, particularly showing the reduced respiration rate in Trial 2.

Overall, the study showed an apparent reduction in quality loss during harvest-to-crush delays under cool and dry conditions. When harvesting unburnt cane, the use of chemical ripeners is advisable to enhance maturity and hence reduce losses during unanticipated delays. The application of antimicrobial solutions to cut ends may reduce infection and the resultant quality losses during the BHTCD. The effect of humidity on quality suggests the importance of reducing the BHTCD during the humid summer months, or even reducing the milling season to minimise activity during these months.

Table 1. Quality parameters measured during storage.

Variety	Section	Total counts Log_{10} (cfu/g FW)		Lactic acid (g/100g)		Respiration rate (CO_2 ml/kg/h)	
		Trial 1	Trial 2	Trial 1	Trial 2	Trial 1	Trial 2
N12	Top	5.557^{h}	5.094^{ef}	0.0483^{ab}	0.2990^{bc}	6120^{d}	1401^{a}
	Middle	5.002^{de}	4.571^{b}	0.000^{a}	0.2563^{abc}	2204^{abc}	2500^{bc}
	Bottom	5.242^{fg}	4.928^{d}	0.0753^{ab}	0.6088^{d}	3021^{c}	1907^{ab}
N31	Top	5.829^{i}	4.908^{d}	0.0322^{ab}	0.4486^{cd}	5725^{d}	1783^{ab}
	Middle	4.743^{c}	2.783^{a}	0.000^{a}	0.2990^{bc}	1641^{ab}	2261^{abc}
	Bottom	5.306^{g}	5.117^{ef}	0.0387^{ab}	0.9836^{e}	2948^{c}	1438^{a}

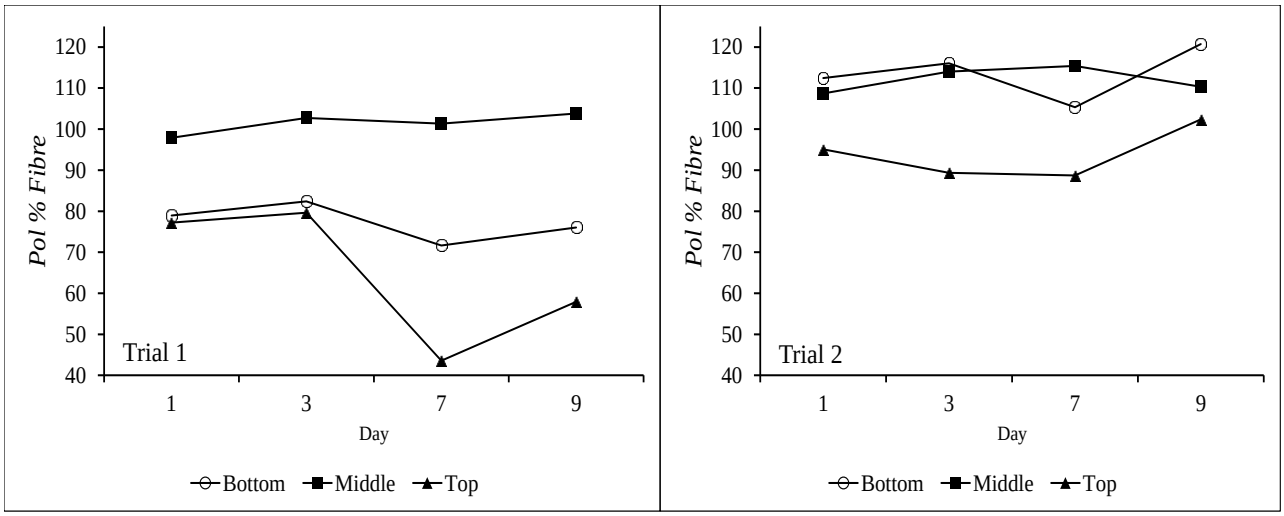

Figure 1. Pol % Fibre changes in Trials 1 and 2.

Acknowledgements

The funding of this study by SASRI is appreciated. Environmental data was graciously provided by Prof Michael Savage in the discipline of Agrometeorology at the University of KwaZulu-Natal, Pietermaritzburg. Technical support from the staff in the disciplines of Plant Pathology and Horticulture at the University of KwaZulu-Natal, Pietermaritzburg, is also acknowledged.

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