GROWTH AND QUALITY OF FOUR SUGARCANE VARIETIES AS INFLUENCED BY AGE AND SEASON

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Abstract

A trial was established which permitted the monthly sampling of 18 ages and 4 varieties of cane for studies on growth and quality. The varieties were NCo 376, NCo 310, CP 29/116 and Co 462. In presentation of results, seasonal effects were averaged to determine the effects of age independent of season, and *vice versa*. Estimated recoverable sugar % cane improved rapidly until 12 to 13 months of age due to a decline in moisture and increases in sucrose % and purity. After this age there was little change in quality and fibre did not increase with age after 14 months. Cane quality was lowest about March and highest about September but there were varietal differences. The seasonal improvement of quality was the product of decreasing moisture and increasing brix and, after April, purity. The decline in quality in the late season was due to increasing moisture and fibre % cane (until December) together with decreasing brix. Dry matter content had a greater influence on fluctuations of ers % cane than did the proportion of dry matter converted to sucrose. NCo 310 had the best quality followed by Co 462, NCo 376 and CP 29/116 in that order. NCo 376 had the highest fibre, except during the early season, and its quality declined with age. Growth parameters were measured weekly until the cane was six months old; height and node development were only affected by seasonal changes, while stalk counts were affected by age and season. Variety also had a marked effect on stalk counts, and varieties also differed in height, but not in node counts.

Introduction

Basic information on quality and growth of the major varieties was required for the Rhodesian Sugar Industry and in 1967 a trial was initiated which, although not giving yield data, provided a mass of information on a number of growth and cane quality parameters. Gosnell and Koenig[1] discussed variations in cane quality, based mainly on estate data, and Lonsdale and Gosnell[2] presented results on the effect of age and season on quality, but these were restricted to the actual milling season and did not include information on growth. Rostron[3] reported on growth in irrigated cane in South Africa. This paper gives local information on growth and quality fluctuations for all months of the year.

Methods

Starting in November 1967, 18 plots of 4 varieties were planted in consecutive months so that the first plot was 18 months old when the last was planted. The experiment was not statistically designed. The varieties were NCo 376, NCo 310, CP 29/116 and Co 462. Plot sizes were 15 m × 9 m and were sprinkler-irrigated, receiving 51 mm irrigation net at 0,84 of pan evaporation. An irrigation designed to bring the soil to field capacity was applied 4 days before each sampling for sucrose determinations.

Height measurements, stalk counts and leaf counts were done weekly. Height was measured from pegs, installed at the base of 10 stalks per plot, to the top visible dewlap. Counts of newly-emerged leaves were made weekly on 10 stalks per plot and the results were used as a measure of node development.

Stalk counts were made on one 12 m row per plot. All these determinations were done until the crop was approximately 6 months old, when the cane had begun to lodge, or was too large to continue growth measurements without danger of damaging stalks.

All plots 9 months old and older had 24 stalks cut from each variety on the 10th day of each month. The samples were subjected to direct cane analysis for sucrose, brix and fibre, tissue moisture determinations and foliar analysis. In the plant crop only sucrose % cane was determined. In the ratoon crops, ers % cane was calculated as follows:

ers % cane = sucrose − 0,451 (brix − sucrose) − 0,077 fibre.

Plots were ratooned at 27 months of age in the plant crop and 24 months in the 1st ratoon. The experiment was terminated when the last 2nd ratoon plot had attained 18 months of age.

Data comparing the various parameters at different crop ages were presented as the means of results for 9 months of the year (plant crop — May to January; 1st ratoon — August to April; and 2nd ratoon — June to February). Data for ages above 18 months were the means of results for 9 months (February — October) for the plant crop only. Seasonal data were presented as the means of ages 9–15 months. In this way the effect of age was obtained eliminating seasonal influences, and *vice versa*. With fewer data available for node (leaf) and height measurements, it was not possible to average the same ages in all cases, but as there appeared to be no measurable effect of age, up to 24 weeks, it is considered that the results are valid.

Results

Estimated recoverable sugar % cane

(*a*) *Age* (Fig. 1)

The recoverable sugar content of all varieties rose rapidly until 12–13 months, after which only minor effects of age were observed. These were as follows: CP 29/116 maintained a gradual increase to 27 months; NCo 310 also showed a slight increase; Co 462 appeared to decline to 18 months followed by a rise; while NCo 376 showed a gradual decline in ers from 14 to 27 months.

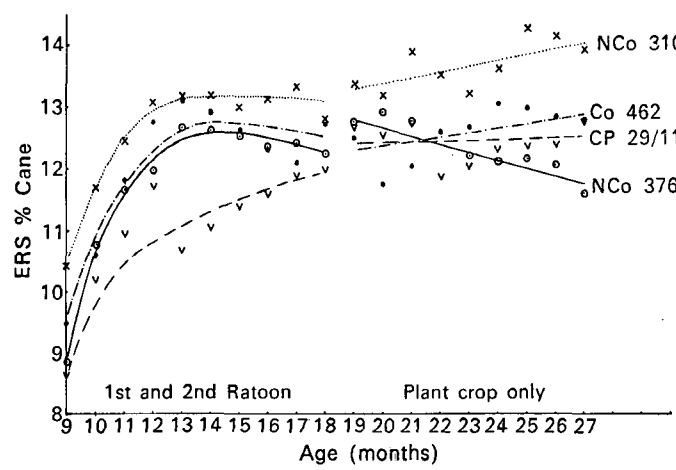

FIGURE 1 Effect of age on ers % cane.

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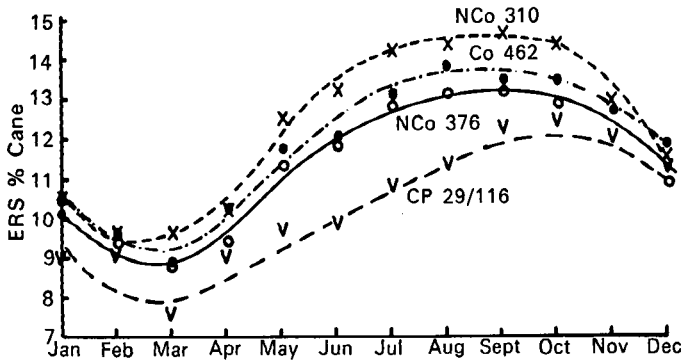

FIGURE 2 Effect of season on ers % cane.

CP 29/116 was substantially lower in quality than the other varieties from 10 to 17 months of age and NCo 376 was lowest after 24 months. NCo 310 maintained the best quality at all ages.

(*b*) *Season* (Fig. 2)

The ers % cane was generally lowest in March, except for NCo 310 which was lowest in February. It was highest about September with Co 462 peaking in August, CP 29/116 in October and NCo 376 and NCo 310 in September.

CP 29/116 had the lowest sucrose content except in November and December. NCo 310, although having average quality between December and March, was above average between March and December. These results confirm that NCo 310 should be cut early to mid-season and CP 29/116 at the end of the season.

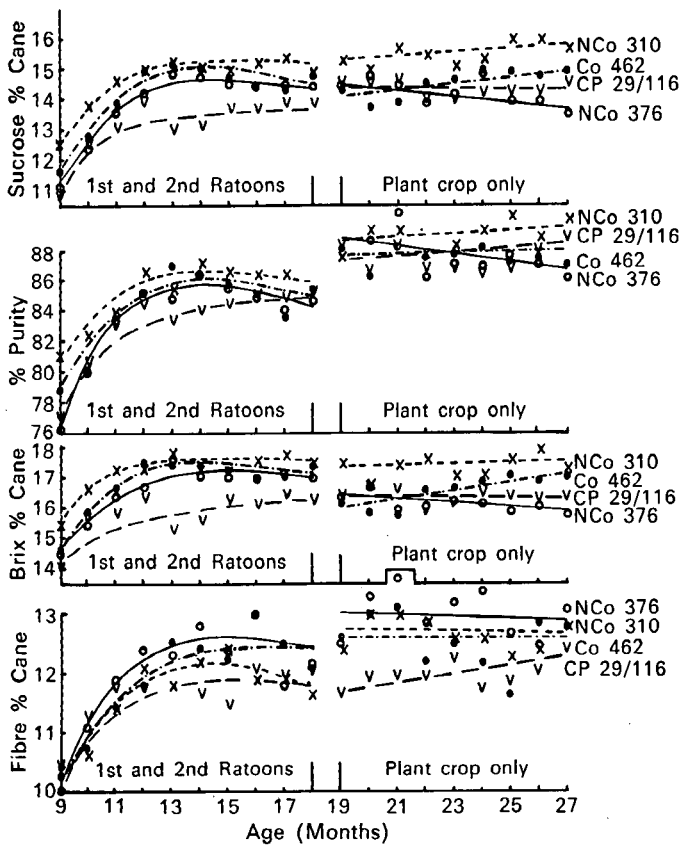

FIGURE 3 Effect of age on the components of quality.

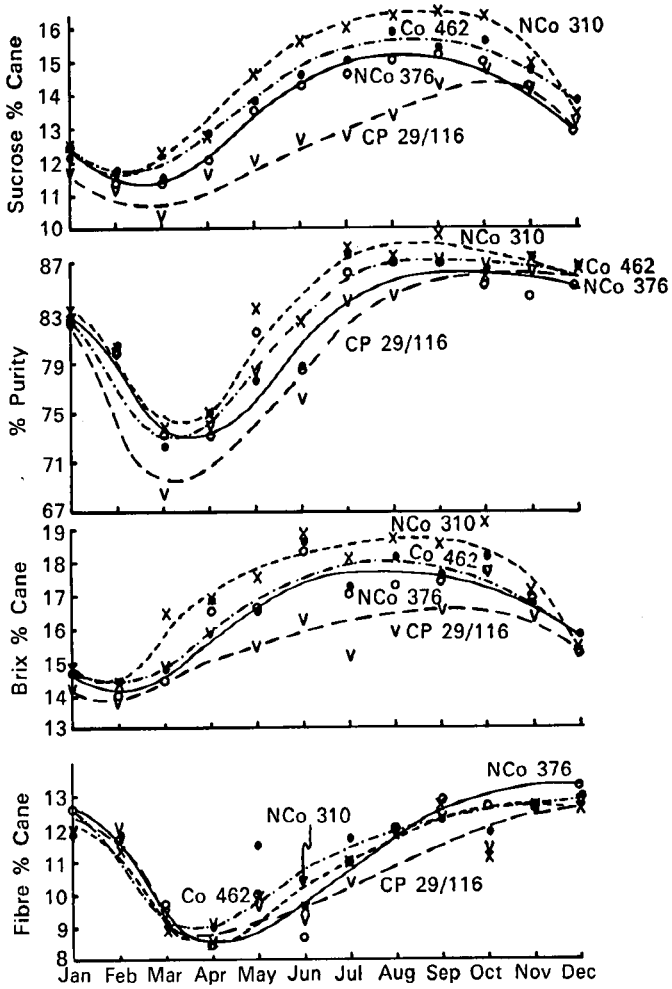

FIGURE 4 Effect of season on the components of quality.

Components of quality

(*a*) *Age* (Fig. 3)

The sucrose and brix contents and the purity of juice of the varieties showed the same fluctuations with age as described for ers % cane. The fibre content increased until 14 months of age and then appeared to remain constant until 27 months of age, except in CP 29/116, in which it showed a gradual increase after 18 months of age.

NCo 376 had the highest fibre content and CP 29/116 the lowest; however, the differences between varieties were small.

(*b*) *Season* (Fig. 4)

Sucrose and brix contents showed similar seasonal fluctuation to ers % cane, except that brix content tended to peak earlier in the season and its peak was not as clearly defined as with sucrose % cane.

Purity of juice was lowest in March but rose rapidly until July, after which it was fairly constant until December. Although the purities of juices from the different varieties showed similar trends to those of sucrose and ers % cane, the purity of juice from CP 29/116 was only slightly below that from the other varieties.

Fibre % cane tended to be lowest in April and highest in December, with NCo 376 showing the greatest fluctuation. There was, however, relatively little difference between varieties.

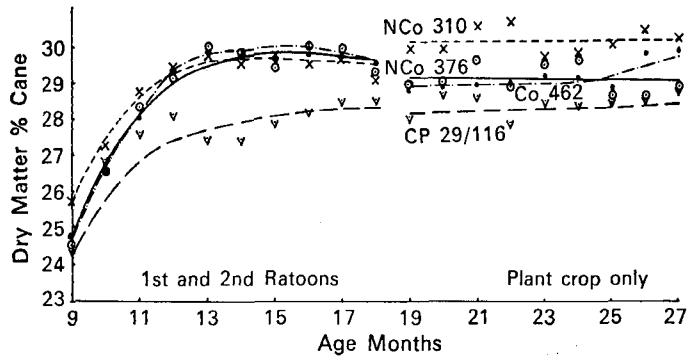

FIGURE 5 Effect of age on dry matter content.

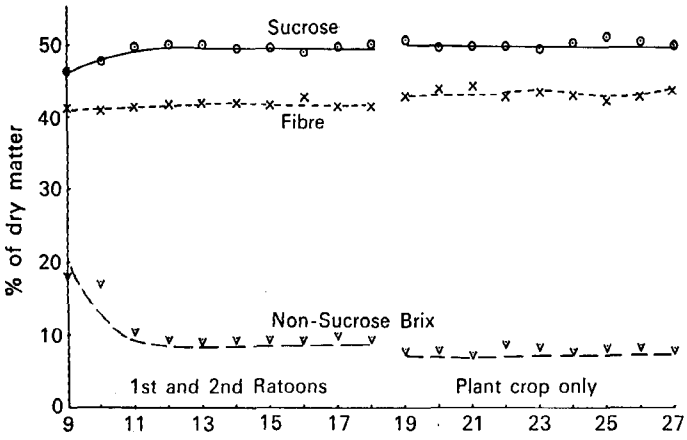

FIGURE 6 Effect of age on dry matter components.

Dry matter in cane

(*a*) *Age* (Figs. 5 and 6)

Dry matter % cane increased fairly rapidly until 13 months of age and then remained fairly constant until 27 months. Although NCo 310 had the highest sucrose content throughout it only had the highest dry matter content after 18 months. CP 29/116 had the lowest dry matter content.

Sucrose % dry matter increased up to 12 months of age due to a decline in non-sucrose solids, after which it remained fairly constant (Fig. 6). Fibre % dry matter showed only minor increases with increasing age.

(*b*) *Season* (Figs. 7 and 8)

Fluctuations in dry matter content of cane with season and variety were similar to the fluctuations in sucrose content; i.e. it peaked in September — October and was lowest in March.

From February to April, sucrose % dry matter increased due to a decline in fibre content and from April to June because of a decrease in other soluble solids. Sucrose % dry matter decreased after October because of an increase in fibre % dry matter.

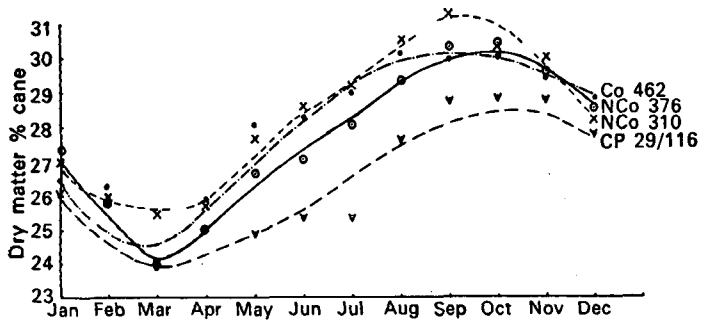

FIGURE 7 Effect of season on dry matter content.

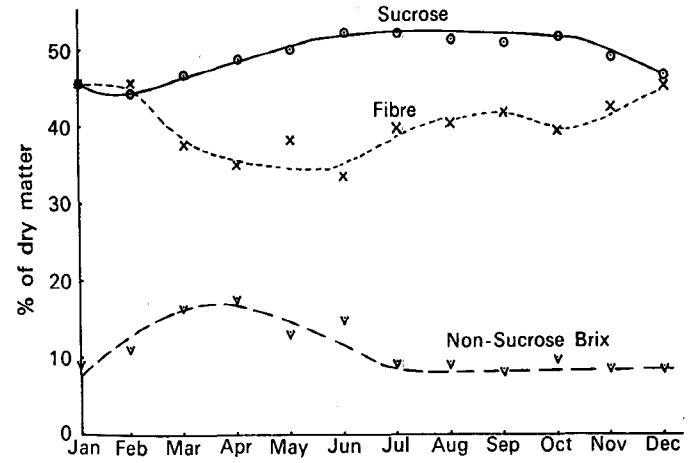

FIGURE 8 Effect of season on dry matter components.

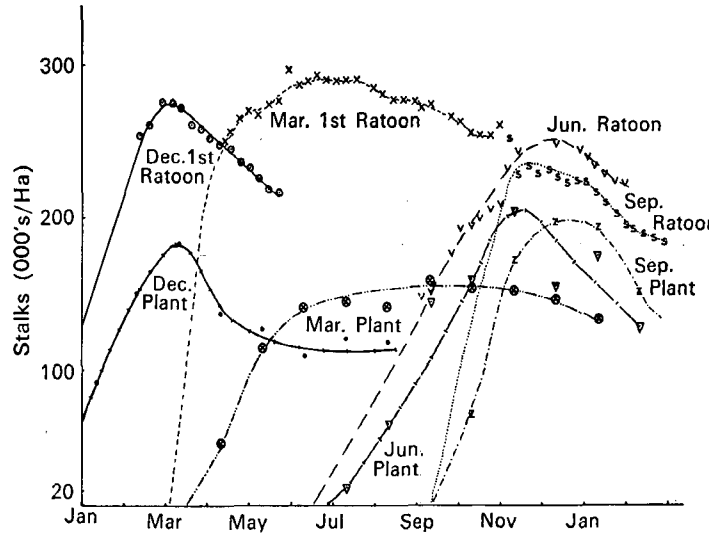

FIGURE 9 Effect of season and ratoon on stalk population.

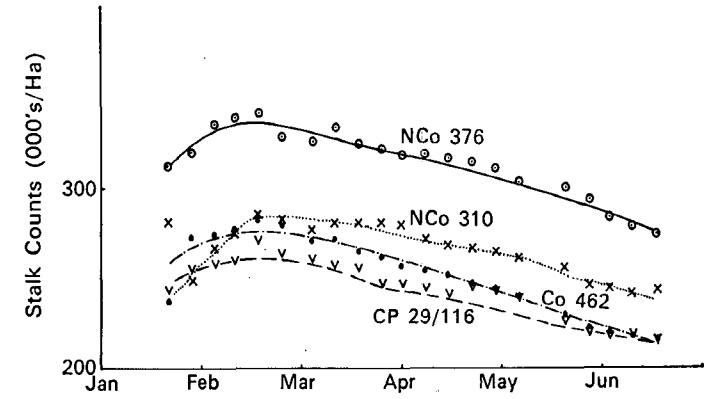

FIGURE 10 Stalk counts of a varieties ratooned in December (2nd Ratoon).

Stalk counts (Figs. 9 and 10)

Weekly stalk counts were made for each monthly planting; however, for the sake of clarity, only quarterly means are shown.

In the early stages of growth the population was influenced mainly by season.

Stalk population increased rapidly when cane was planted or ratooned in spring and summer (September/December) and relatively slowly with March and June plant and ratoons. Conversely, the period of peak population was longer and the rate of shoot mortality slowed with March and June plant and ratoons.

The plant crop had a much lower population than that of the first ratoon crop which was in turn lower than that of the 2nd ratoon.

NCo 376 consistently had the highest population while NCo 310 usually had the next highest stalk count, followed by Co 462, with CP 29/116 the lowest.

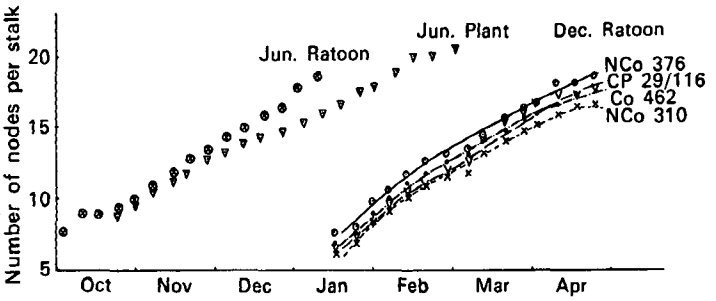

FIGURE 11 Effect of ratoon, variety and season on development of nodes (1st Ratoon).

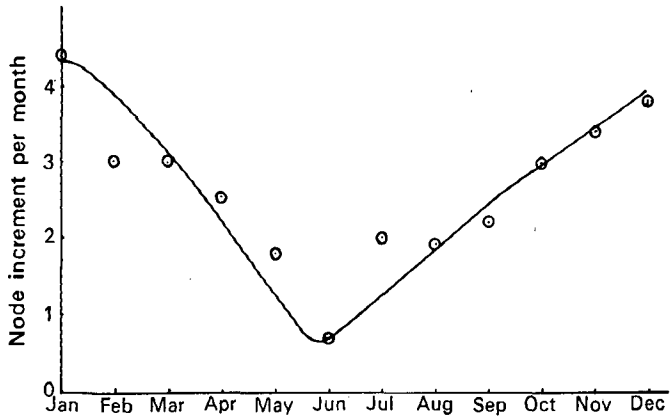

FIGURE 12 Effect of season on rate of node development (1st Ratoon).

Node development (Figs. 11 and 12)

Node development, as measured by leaf counts, was not noticeably influenced by age up to 6 months, as shown by the fact that during December and January the June ratoon, although much older, retained a similar rate of node development to the December ratoon.

There was very little difference between the development of nodes of different varieties and ratoons (Fig. 11). Node development was strongly influenced by season; however, node development was lowest in June and highest in December (Fig. 12).

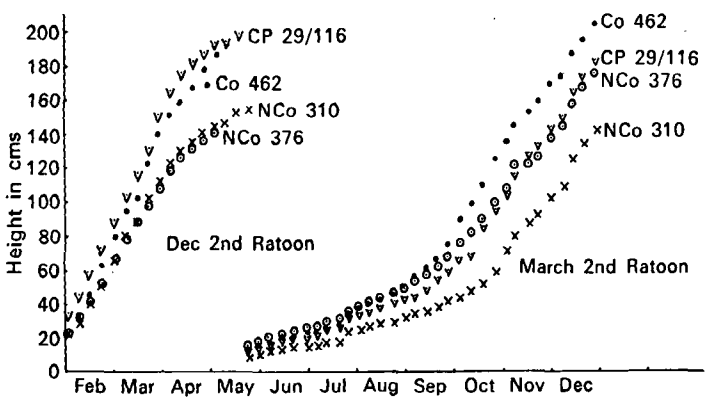

FIGURE 13 Growth of a December and a March crop.

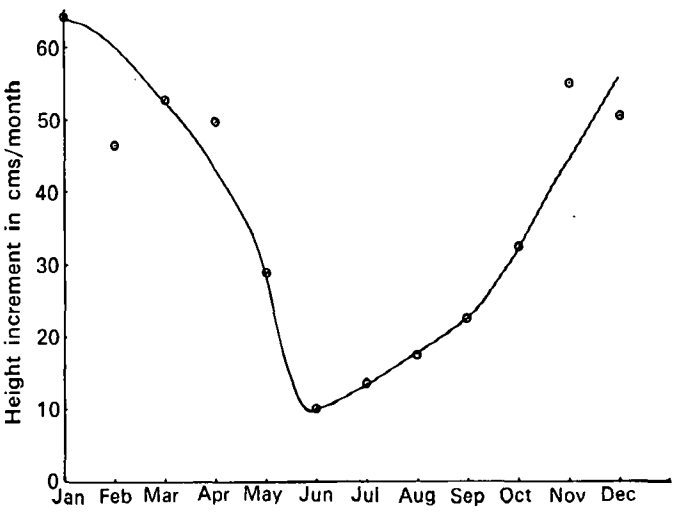

FIGURE 14 Rate of growth of 1st Ratoon crop in different seasons.

Height (Figs. 13 and 14)

No effect of age on rate of growth could be detected up to 6 months and it appears that the rate of growth was mainly determined by seasonal effects.

Varieties gave slightly inconsistent results but generally Co 462 had the fastest rate of growth followed by CP 29/116, NCo 376 and finally NCo 310.

The rate of growth was highest in January and lowest in June (Fig. 14). The rate of growth in May was similar to that in September and October.

Discussion

(*a*) *Effect of age on quality*

Within the range of ages studied (9–27 months) there were no major changes in quality. The ers % cane, despite a simultaneous increase in fibre % cane, increased rapidly until about 12–13 months of age, due to a decrease in moisture content and increases in brix % cane and % juice purity. The proportion of dry matter converted to sucrose increased while fibre % dry matter was unaltered.

The marked similarity between the effect of age on ers % cane and its effect on dry matter % cane, indicate that this factor has a greater effect than the proportion of dry matter converted to sucrose.

After 13 months of age, ers % cane showed little change except in CP 29/116, where it showed a gradual improvement in quality until 27 months of age. NCo 376 continued to decline in quality while Co 462 and NCo 310 showed minor improvements in quality after 18 months of age. This tends to confirm the findings of Lonsdale and Gosnell[2] who concluded that the practice of carrying over from the end of one season to the next cannot be recommended.

Rather surprisingly, fibre content did not increase with age after 14 months, as is generally believed that it does. This was also observed by Lonsdale and Gosnell[2] who showed that fibre increases with age in certain seasons, while in others it decreases.

(*b*) *Effect of season on quality*

The ers % cane fluctuated about a low value in March and peaked in about September. There were, however, varietal differences; NCo 310 had its lowest ers content in February and the other varieties in March. This demonstrates the more rapid seasonal increase in ers % cane of NCo 310. CP 29/116 peaked in October, NCo 310 and NCo 376 in September and Co 462 in August. This generally confirms the findings of

Gosnell and Koenig.[1] The early season increase in ers % cane was the product of decreasing moisture content and increasing brix content, and after April, increasing juice purity. The late season decline was the product of increasing moisture content and fibre % cane (until December), together with decreasing brix content and, after November, juice purity.

NCo 376 showed greatest seasonal fluctuation in fibre % cane, having the highest fibre in December and the lowest in April. CP 29/116 had the lowest quality except in December and over 18 months of age. Co 462 quality peaked in August, NCo 310 and NCo 376 in September and CP 29/116 in October. NCo 310 quality was lowest in February and the others in March.

(c) *Growth*

Age had no effect on the rate of growth up to 6 months.

The factors affecting population were mainly the ratoon status of the developing crop, season and the variety. The development of nodes and rate of height growth were predominantly affected by season; both increased during the hotter months.

Height increments in May were comparable with those of late September. As the rate of node development was lower in May, internode length was longer in autumn than spring.

There was a marked difference between varieties in stalk populations, NCo 376 having considerably more stalks than the other varieties. Although not consistently so, NCo 310 usually had the next highest followed by Co 462 and, finally, CP 29/116. Variety had no consistent effect on node development and ratoon status had no consistent effect on either node development or height.

Varieties differed in height and although not very consistently so, Co 462 was generally tallest followed by CP 29/116, NCo 376 and, finally, NCo 310.

Acknowledgements

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