A LARGE VARIETAL DIFFERENCE IN CANE DETERIORATION DUE TO FLOWERING

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Abstract

Two heavily flowered commercial varieties, NCo 376 and N52/219, were sampled monthly from replicated plots from August (age 9 months) to April (age 17 months). The following parameters were measured from internodes 6–8, 9–11, 12–14 and the remainder: sucrose, fibre, moisture, invert sugar and ers % cane; juice purity, stalk weight, stalk length and number of side shoots, extent of pith, and necrosis. A very large difference was observed in cane deterioration between the two varieties; e.g. ers % cane in NCo 376 in April (age 17 months) was less than 1% whereas in N52/219 it was more than 12%. It was apparent that maintenance of acceptable levels of ers % cane through the mill shut-down period (January–March inclusive) was dependent on the production of reasonable numbers and sizes of sideshoots, which were almost entirely absent in NCo 376.

Introduction

The results described in this paper were derived from plots which remained from an earlier experiment laid down to determine crop losses due to flowering. Two varieties, NCo 376 and N52/219, were growing on a basalt clay soil, and both flowered heavily. It was thus possible to study the quality of flowered sugarcane of these two varieties for a considerable period after flowering. Large varietal differences in cane deterioration are well known and Rao,[1] reporting on two West Indian varieties, observed that absence of side shoots eventually led to rotting of cane at 8–9 months of age, whereas the presence of even two side shoots appeared to keep the stalk alive, and possibly contributed some sugar, even though they did not grow. Stehlé,[2] in a very comprehensive paper dealing with varietal deterioration after flowering, showed that some varieties have higher sucrose % juice when flowered, and others when unflowered. He also discussed the significance of side shoots and showed that the total length of cane fit for crushing (i.e. mother stalks, tillers and side shoots) in a stool around 20 stalks was usually much higher when the incidence of flowering was high. He differentiated between side shoots on the upper nodes and those at the base of the stool, the latter being late shoots (if considered in relation to season) which are, in fact, premature ratoons. Thus, although in this study direct correlation is shown between lack of side shoots and deterioration of flowered cane, the matter is apparently more complex than it appears at first sight. Nevertheless, it is hoped that the data reported here will be a useful contribution to the study of the subject.

Experimental methods

Floral initiation having presumably occurred between March 1st and March 20th (photoperiod 12,5 hrs), flowering assessment was possible in July. Starting in August, 50 flowered stalks of normal healthy appearance were brought to the laboratory and each stalk was severed at node 6, the uppermost flag leaf being designated leaf number 1. The stalks were then cut into the following sections: internodes 6–8, 9–11, 12–14 and the remainder, in order to observe the quality variations throughout the stalk. The weights of the various sections were also recorded and weighted means were later used to calculate the ers % cane for the whole stalk. The samples were analysed by the direct method[3] using a Jeffco cutter-grinder and cold extractors. The following items were determined: sucrose % cane, refractometer brix % cane, moisture % cane, fibre % cane (= 100 − brix − moisture), and invert sugar % cane (Lane-Eynon method — Meade[4]). The following were calculated: purity % juice, ers % cane, and ers weight per 100 stalks. Additionally, extent and amount of pith were recorded (0 = no pith, 9 = internode filled with pith). In order to correlate side shooting with deterioration, the percentage of stalks with shoots at each node and the mean length of shoots were recorded. In the case of NCo 376, the percentage of stalks showing total and partial necrosis was recorded.

Side shoots, when present, were left intact when sectioning the stalk, so that, for example, the top of a side shoot originating at node 9 would be milled with internodes 6–8.

Results

Sucrose % cane (Figure 1)

Figure 1 shows the comparison of the two varieties for each section of stalk for a period of 9 months after the peak flush of flowering (August). The variations of sucrose content in the

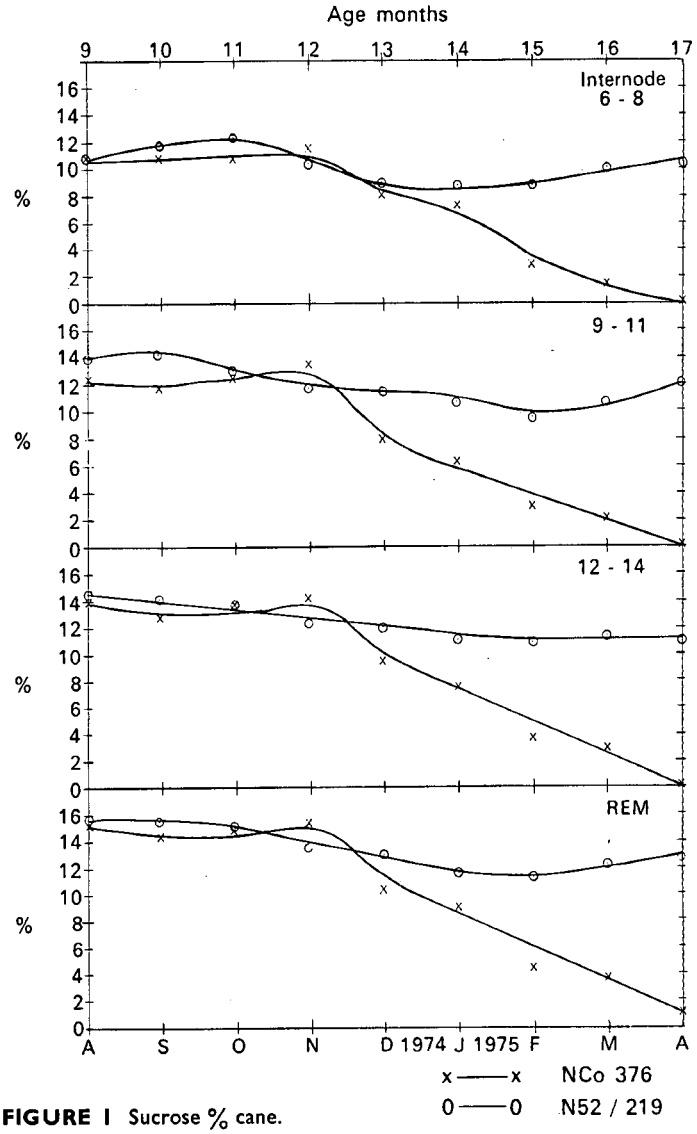

FIGURE 1 Sucrose % cane.

different sections were very similar and it is interesting to note that up until October (age 11 months) sucrose % cane for NCo 376 was 1–2% higher than that for N52/219, but thereafter it dropped steadily to below 4% in the remainder and around 2% in the upper sections. Conversely N52/219 actually showed a slight upward swing to around 14% in April (17 months).

Fibre % cane (Figure 2)

All sections, as would be expected, showed a steep rise in fibre content for both varieties between 9 and 10 months of age as maturity approached. Fibre was about 1–2% higher in N52/219 than in NCo 376 for all sections until October, whereafter the two varieties were similar until November. Thereafter fibre % cane in NCo 376 increased slowly to a level 3–4% higher than that in N52/219 in April (age 17 months).

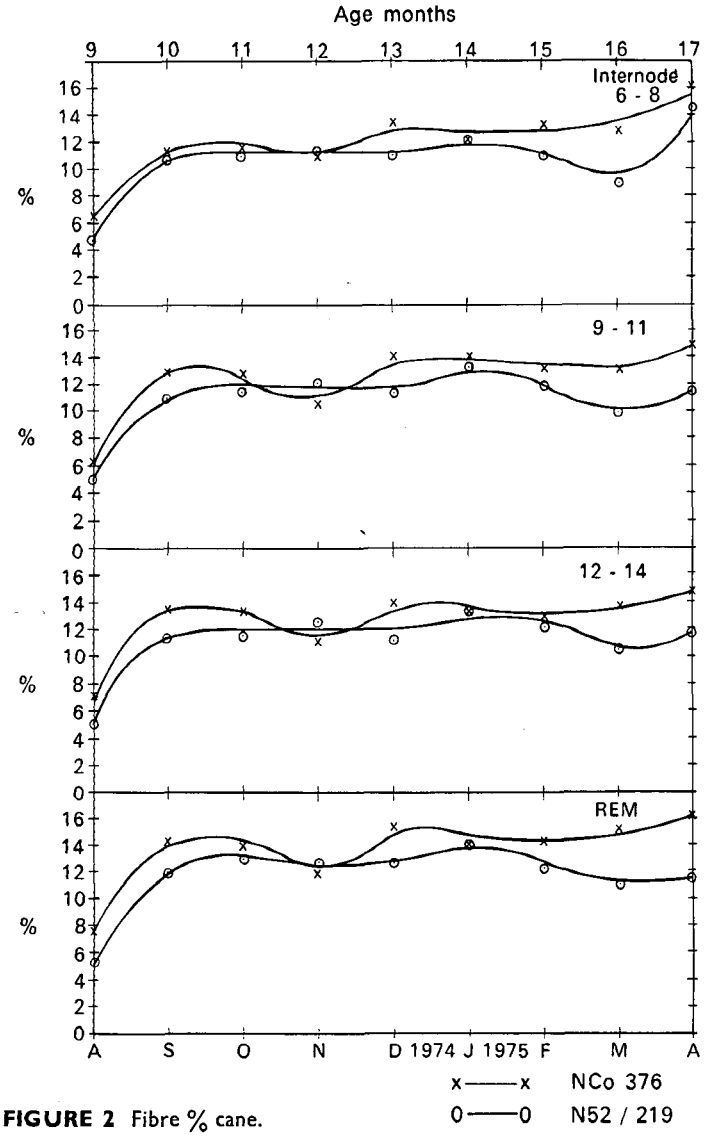

FIGURE 2 Fibre % cane.

*ers % cane** (Figure 3)

There was little or no difference between the variations of ers content in the different sections. The pattern was similar to that for sucrose % cane, NCo 376 dropping in April to zero for the top segments, and even the remainder contained only about 1% of ers. N52/219, however, showed a slight upward trend in all sections, the upper sections being around 12% and the remainder about 13% in April, and rising. It was apparent that NCo 376 was quite worthless and would not warrant transport to the mill.

*ers % cane = (1,451 pol % cane — 0,451 brix % cane) — 0,077 fibre % cane.

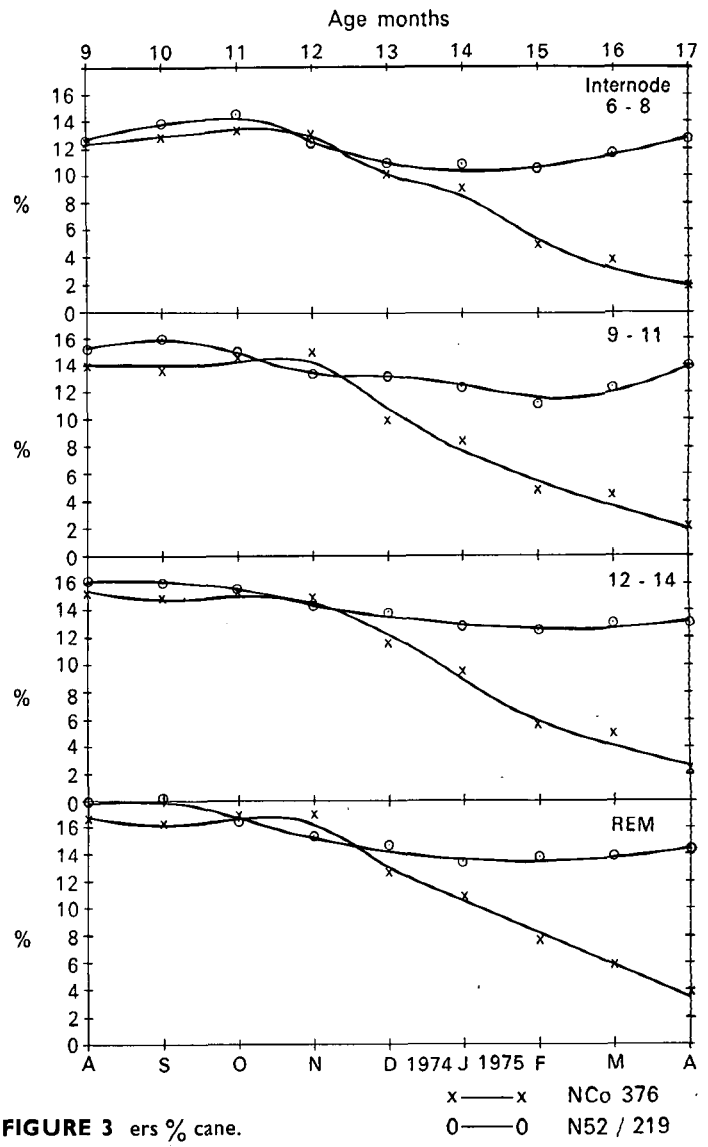

FIGURE 3 ers % cane.

Invert sugar % cane (Figure 4)

This graph shows what is virtually an inverted image of ers % cane for all sections; that is to say, both varieties showed minimal invert sugar content until about early January. Thereafter NCo 376 increased rapidly to a fivefold figure of around 1,6%, and N52/219 remained throughout the entire period at around 0,3%.

Juice purity (Figure 5)

This graph, when considered in association with those for ers % cane and invert sugar % cane, is naturally what one would expect. It shows remarkable consistency of the juice purity for N52/219 for the entire period at around 90% whereas, almost like an inverted image of the invert % cane, the NCo 376 juice purity dropped off rapidly from early January to around 50% in the lower and 30% in the upper stalk.

ers % cane (whole stalk) related to neo-genetic index (Figure 6)

In order to study the relationship between quality deterioration and side shoots, it was decided to calculate an index giving some measure of quantity of new growth. A histogram has been plotted below the ers % cane (whole stalk) graph in Figure 6. This "neo-genetic index" was calculated by multiplying the % shooting stalks by mean shoot length for each node. As can be seen, the index for the rapidly deterioriating

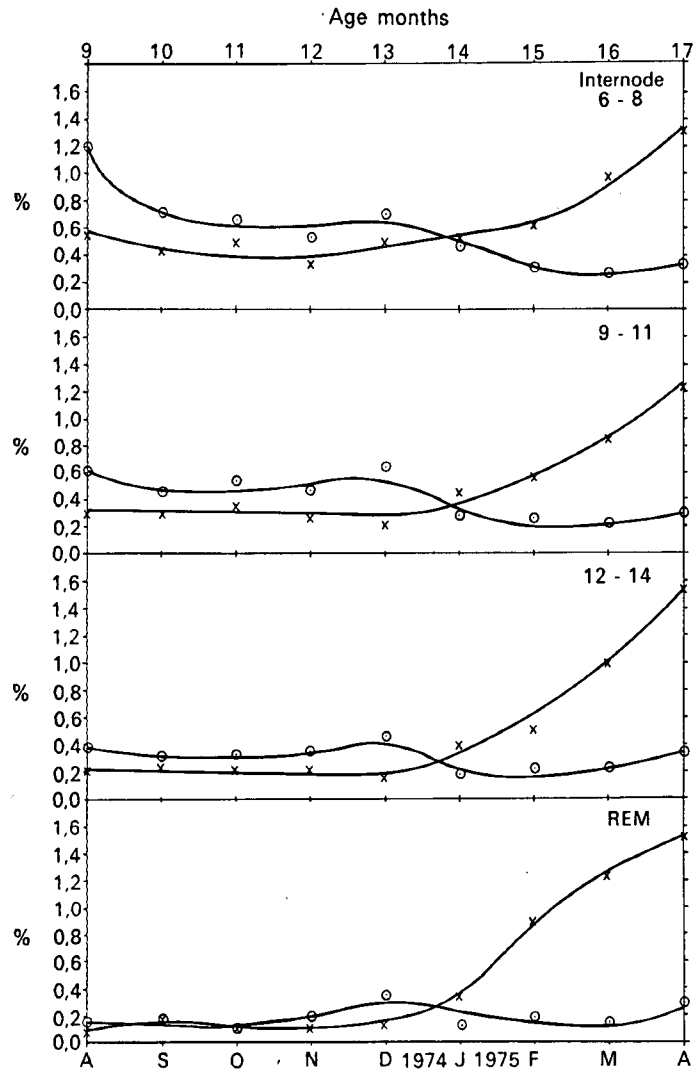

FIGURE 4 Invert % cane.

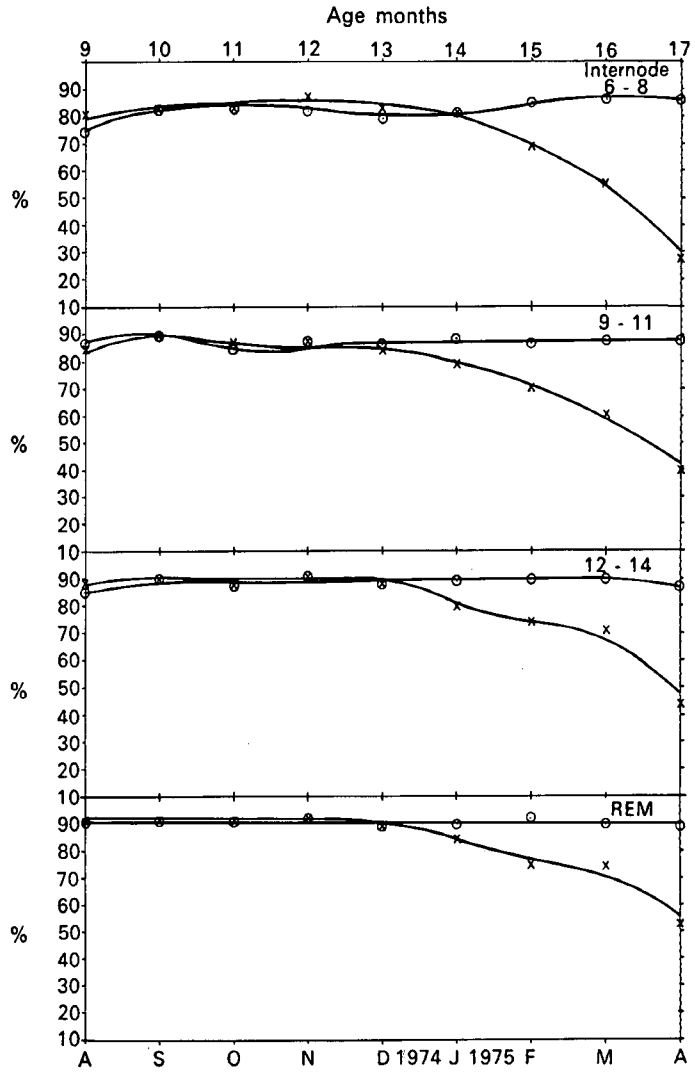

FIGURE 5 Purity.

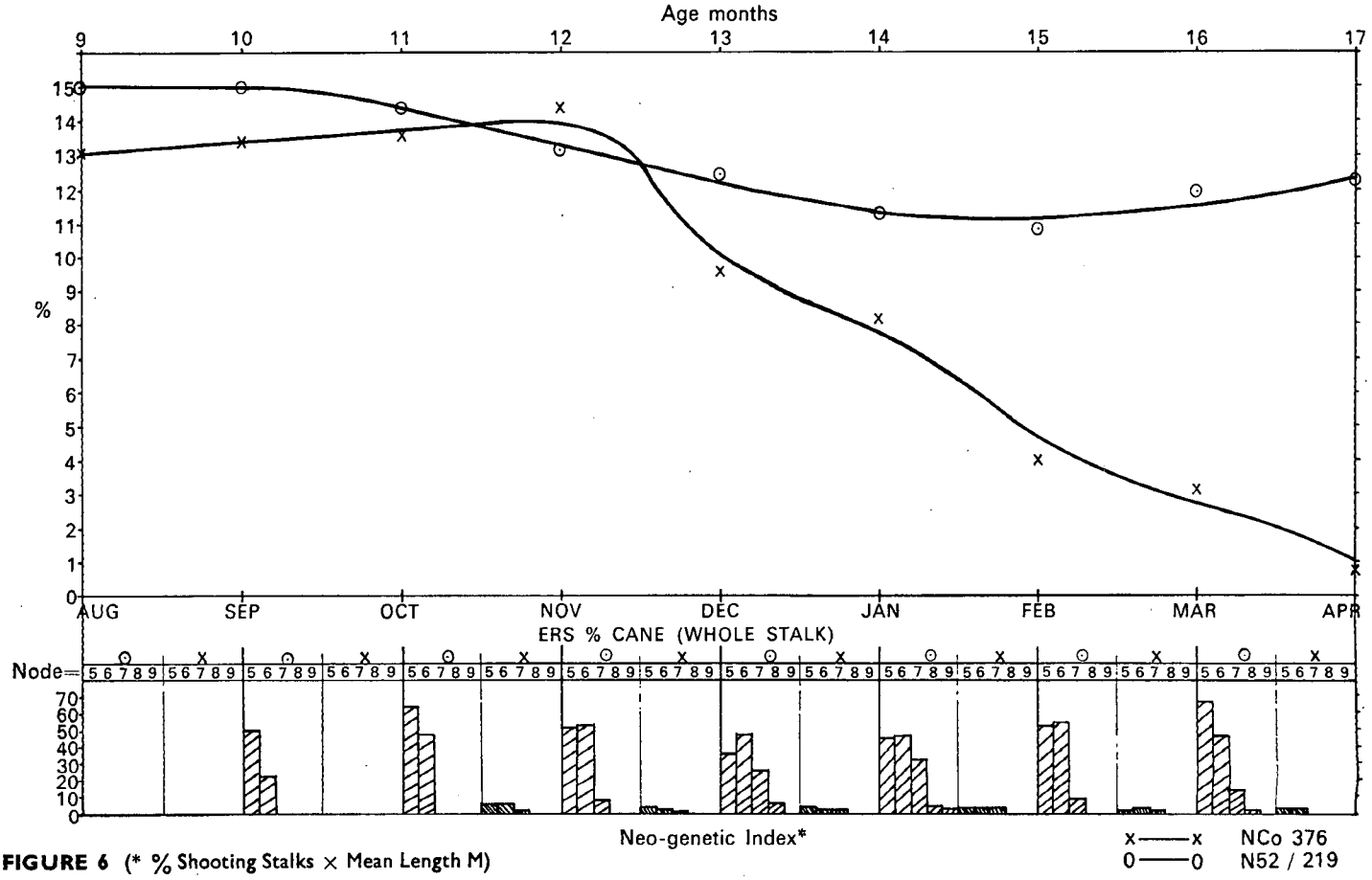

FIGURE 6 (* % Shooting Stalks × Mean Length M)

NCo 376 was extremely small, whereas that for the N52/219 increased progressively, and the ers content actually increased slightly in April.

Weight of ers per 100 stalks

Although this parameter was calculated, it contributes but little to this study because of the very large varietal differences in cane weight recorded, the N52/219 stalks being anything from 30–50% heavier than those of NCo 376 in every month except February, when the two were more or less equal. Thus we see that in August (age 9 months), for example, ers weight per 100 stalks for NCo 376 was 10,16 kg compared with 19,75 kg for N52/219. The number of stalks per hectare for NCo 376 are substantially higher than those for N52/219, a typical ratio being about 3 : 2. When the weight of ers in 100 stalks of N52/219 is multiplied by 2/3 it more nearly approximates the figures for NCo 376 before rapid deterioration started in November.

Estimation of pith and necrosis

From August to January pith estimation in each internode downwards from No. 6 was recorded (0 = no pith, 9 = internode filled with pith). However, the amount and extent of pith was much the same for both varieties, although N52/219 was usually the higher of the two, and this is illustrated in Table 1.

TABLE 1

Ratings of the amounts of pith in internodes of varieties NCo 376 and N52/219 in August, November and January

Node No.		6	7	8	9	10	11	12	13	14
August	NCo 376	4	4	5	4	5	4	3	1	0
	N52/219	5	4	3	3	3	3	3	3	1
November	NCo 376	7	7	6	6	5	5	4	1	0
	N52/219	9	9	8	7	7	6	4	3	1
January	NCo 376	5	5	6	7	7	5	4	1	0
	N52/219	9	9	8	7	5	5	4	3	1

After January this procedure was discontinued owing to a shortage of well-grown and typically flowered stalks in a few plots, and also the pattern emerging was not informative.

In February the first signs of necrosis began to appear in the upper internodes of NCo 376, and in March 60% of stalks had necrosis extending down the entire length, and the remaining 40% down to about internode 14.

Discussion

The problem of flowering has been discussed for at least the past 30 years and although much qualitative and quantitative work on its effects on cane has been done (Stehlé;[2] Stehlé;[5] Evans;[6] Gosnell and Long[7]) only rarely are data given for specific varieties (Rao[1]). Although it is generally agreed that flowering is bad, a lot of work and time is necessary to discover quantitatively just how damaging it is. Furthermore, the answer obviously depends on time of flowering in relation to time of harvest. For example, in Rhodesia cutting normally does not take place from the end of December to the end of March, and since floral initiation occurs around March 1st to March 20th, it is apparent that some fields could commence flowering as early as 2½ months of age. In this study floral initiation would have been at about 4 months of age. Had it been as early as 2½ months of age, we cannot assume that cane weights would have reached the more or less 80 kg per 100 stalks we recorded at age 12 months. Thus, although it would appear that deterioration is not serious for either variety if 12-month-old cane is harvested in November (as seen also in the ers % cane figures for flowered NCo 376 published by Gosnell and Long[7]), it would be interesting to see what would happen to flowered NCo 376 harvested at the end of December or early January at age 12 months (i.e. at the end of the milling season). Such cane would have had floral initiation at about 2½ months of age and it seems very likely that, quite apart from juice quality, cane weight would suffer severely because of stalk elongation ceasing so early in the crop. A point emerging from this study is that, in addition to evaluating yield of new varieties in trials, the flowering behaviour of those likely to be released for commercial use should be investigated if the opportunity occurs (i.e. if sufficient flowering occurs to obtain samples until the end of any possible stand-over period). It is apparent that certain varieties should not be allowed to stand over from one milling season to the next if heavily flowered. It is suggested that ers % cane should be studied in relation to phase of flowering for all commercial varieties.

As regards the significance of side shoots, it is interesting to note that in a previous study in 1973 (Gosnell and Long[7]) the number and length of side shoots recorded for flowered NCo 376 were substantial. For example, in January (age 15 months) there were 128 shoots per 100 stalks with a mean length of 155 cm. This would have made the sum of all node neo-genetic indices for that month 198, compared with 5 in this study at the same age (February). The figure for N52/219 was 114. The almost complete lack of side shoots on NCo 376 in this study is puzzling, the only obvious difference being that in this study floral initiation was at age about 4 months compared with 5 months in 1973. However, one would have thought that the earlier floral initiation occurred, the greater would be the tendency to produce side shoots or tillers. Perhaps tillers are the explanation and, when floral initiation occurs at an early age, they tend to be produced rather than side shoots. If so, then it would be wrong to attempt to evaluate crop loss due to flowering over a long growing period such as 17 months by merely selecting flowered stalks, for the tillers or "premature ratoon" stalks would surely have developed at this age to the point where they would contribute significant amounts of sugar to the yield. It was noted that the field recorders reported in January a shortage of well-grown and typical flowered stalks for pith assessment, over and above the 50 stalks required from each plot for sucrose determination. This was despite the fact that the field was assessed at over 80% flowered in the previous July, and this fact may be of some significance.

Studies concerning flowering are not always easily carried out, and experimental procedures are continuously being improved. The results of this experiment nevertheless indicate clearly that circumstances exist when NCo 376 should not be carried over to a succeeding milling season.

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