# A COMPARISON OF SUCROSE PATTERNS, YIELDS AND THIRD LEAF N % DRY MATTER OF SUGARCANE VARIETIES GROWN IN THE PONGOLA AREA

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**Abstract**

In order to determine the suitability of varieties for the Pongola area, two trials were established at the SASA Experiment Substation at Pongola, one harvested every spring and the other every autumn.

Random samples of cane stalks were taken prior to harvesting and the ERS % C was determined. Using these data it was possible to study the variation in ERS % C with crop age and time of year. It was found that ERS % C increased markedly during the months of April and May and was tending to reach a peak value during September. NCo 310 was superior, in terms of ERS % C, to NCo 376 and NCo 334 in all cases, except in the plant crop of the autumn harvest. The ERS % cane of N52/219 compared favourably with that of NCo 310 in all cases, except in the second ratoon of the spring harvest.

The yields, in terms of tc/ha/100 mm effective water, for NCo 376 and NCo 334 were consistently greater than those of NCo 310 and N52/219 for both the spring and autumn harvests. This resulted in similar yields, in terms of ters/ha/100 mm effective water, for all varieties in all cases. Only in the second ratoon of the spring harvest and in the first ratoon of the autumn harvest was the performance of NCo 376 statistically significantly greater than that of NCo 310.

Third leaf sample analysis indicated that the varieties differed markedly in their foliar N % dm content.

## Introduction

During the 1973-1974 season at Pongola, the variety NCo 310 occupied 54 per cent of the total area of land planted to sugarcane, while NCo 376 occupied 42 per cent, NCo 334 1 per cent and other varieties 3 per cent (Havenga[4]). Havenga states that the switch from NCo 310 to NCo 376 is still taking place too slowly considering the enormous increase in the incidence of smut disease in NCo 310.

In August 1971 and April 1972 two trials were established at the SASA Experiment Substation at Pongola to determine the suitability of eight varieties to a spring harvest cycle, viz. October to October, and an autumn harvest cycle, viz. May to May. The varieties planted were NCo 376, NCo 334, NCo 310, N52/219, N55/805, N51/168, CB 36/14 and N7.

Only the yields of the first four varieties have been considered for this paper as these are considered the important varieties for the Pongola area. Observations at Pongola have shown that NCo 310, N55/805 and N7 are susceptible to smut disease, while CB 36/14 and N51/168 have not performed well. The variety N52/219 has recently been released and is resistant to smut disease.

Rostron[9] harvested 40 week-old-cane during the months of January, March, May, June, August and October at Pongola and determined the sucrose per cent cane at each harvest. He found that the sucrose was low in January, gradually increasing through to March with a marked increase occurring between March and May, and finally reaching a peak value at the end of August. Stalk samples were taken in both of the variety trials to confirm this reported trend and to observe whether there were differences between varieties in their estimated recoverable sugar per cent cane (ERS % C) with respect to the time of year. Gosnell[2] had found the latter to be the case in Rhodesia.

Gosnell and Long[3] noted the influence of variety on the nitrogen content of the third leaf. They also noted that increasing crop age caused very large reductions in foliar N, while season also had marked effects on N, which declined markedly between August and April. In an experiment at Shaka's Kraal on a Waldene (Dwyka) fine sandy loam, Moberly[7] found that the uptake of N was more efficient in crops grown during a spring harvest cycle, compared with an autumn harvest cycle. Third leaf samples were therefore taken in both trials to see whether the same trends in foliar N could be detected for sugarcane grown in the Pongola area.

A split-plot design was used for both trials, where two levels of nitrogen fertilizer were applied to the eight varieties. So far the response to the higher level of N has been inconsistent and therefore the mean yields, ERS % C and the third leaf N contents, for both levels of N, have been used in this paper.

## Procedure

The experiments were planted on a soil of the Makatini series and were fully irrigated. Both trials received 60 mm of effective irrigation water applied on a minimum 25 day cycle. The drying-off period was 10 to 11 weeks in all cases. The dates of planting and harvesting, and the crop age at harvest are presented in Table 1.

**TABLE 1**

**The dates of planting and harvesting, and the crop age at harvest for the spring and autumn harvests**

| Spring harvest | | | | | | | Autumn harvest | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Plant date | Plant crop | | 1st ratoon | | 2nd ratoon | | Plant date | Plant crop | | 1st ratoon | |
| | Date | Age | Date | Age | Date | Age | | Date | Age | Date | Age |
| 23/8/71 | 17/10/73 | 13,8 | 3/10/73 | 11,5 | 24/9/74 | 11,7 | 12/4/72 | 30/5/73 | 13,6 | 18/5/74 | 11,6 |

The total water (irrigation + rain) received by each crop is given in Table 2.

**TABLE 2**
**The total water (mm) received by each crop**

| Spring | | | Autumn | |
|---|---|---|---|---|
| Plant | R1 | R2 | Plant | R1 |
| 1 645 | 1 272 | 1 195 | 1 264 | 1 389 |

For the spring harvest, the two levels of N for the plant crop were 50 and 100 kg N/ha, for the first ratoon 60 and 120 kg N/ha and split applications totalling 110 and 220 kg N/ha for the second ratoon. Both the plant and first ratoon of the autumn harvest received 60 and 120 kg N/ha.

## Results

### *ERS % C*

The trends in ERS % C, from two months prior to harvest, for varieties NCo 376, NCo 334, NCo 310 and N52/219 harvested in spring and autumn, are presented in Figure 1.

The results for the spring harvest indicate that ERS % C tended to peak during the month of October. In all cases the ERS % C of NCo 310 was higher than that of NCo 376 and NCo 334, and greater than that of N52/219 at the first and third samplings of the first ratoon and at all the samplings in the second ratoon. The ERS % C of N52/219 was higher than that of NCo 376 and NCo 334 at all samplings in the first ratoon and at the first sampling in the plant crop.

The ERS % C for all the varieties was slightly lower in the second ratoon crop when compared with the first ratoon crop results. However, it would appear that the ERS % C for N52/219 decreased more, relative to the other varieties, in the second ratoon crop. The results of subsequent ratoon crops will indicate whether the ERS % C of N52/219 is reduced with successive ratoons, or whether the observed trend is coincidence.

The data for the autumn harvest show that the ERS % C of all varieties increased markedly during the months of March, April and May. For the plant crop no statistically significant differences were obtained between the varieties at any of the samplings, although NCo 310 and N52/219 gave consistently higher values than did NCo 376 and NCo 334. In the first ratoon crop, the ERS % C for NCo 310 and N52/219 was statistically significantly greater than that of NCo 376 and NCo 334 for all samplings. The difference was approximately the same for the months of March and April, but was considerably less during May.

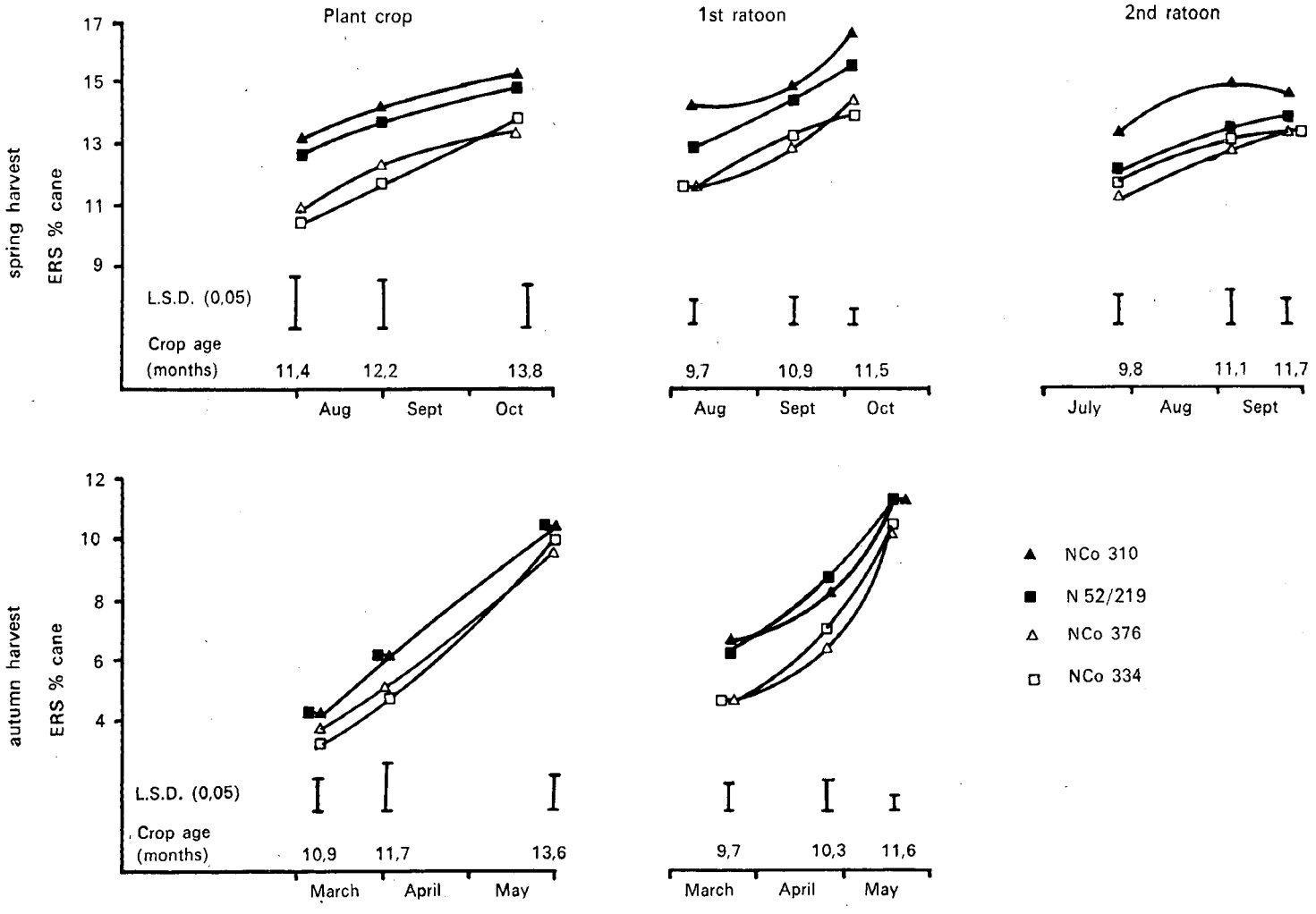


**FIGURE 1** Trends in ERS % C from 2 months prior to harvest for the plant and ratoon crops of 4 varieties harvested in spring and autumn.

*Yields of cane*

The yield in tc/ha/100 mm effective water, from the four varieties for the plant and ratoon crops of the spring and autumn harvests is given in Figure 2.

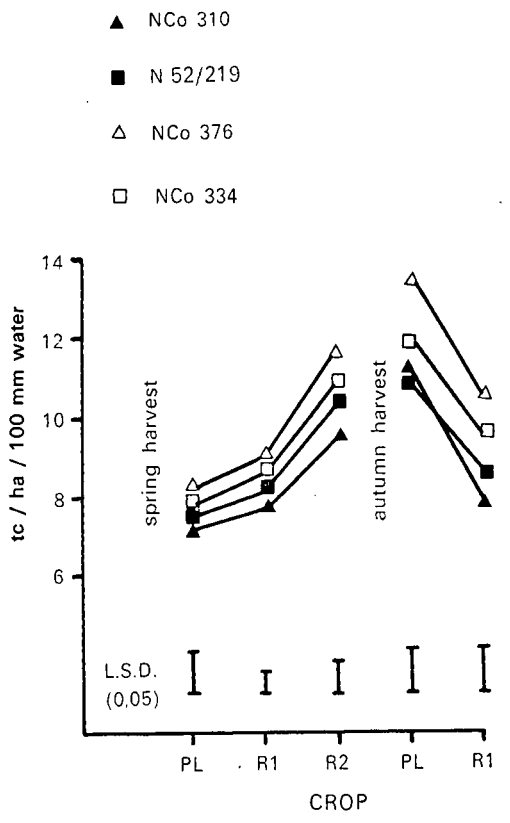


**FIGURE 2** Tons cane/ha/100 mm effective water for the plant and ratoon crops of 4 varieties harvested in spring and autumn.

The tc/ha for all varieties harvested in spring decreased for the first ratoon and then increased for the second ratoon crops. In terms of tc/ha/100 mm effective water, the same trend was not observed; there has been a steady increase in yield with successive ratoons. For the crops harvested in autumn the yield was lower in the first ratoon crop, when compared with the plant crop, for both tc/ha and tc/ha/100 mm effective water.

The yield of NCo 376 has been the highest at all harvests, both for the spring and autumn harvests, followed by NCo 334, N52/219 and then NCo 310. In the plant crop of the spring harvest, no statistically significant yield differences were obtained between varieties. However, in all other cases NCo 310 yielded statistically significantly less than NCo 376 and NCo 334, while N52/219 has yielded statistically significantly less than NCo 376. Only in the second ratoon of the spring harvest did N52/219 yield statistically significantly more than NCo 310.

*Sugar yields*

The ERS % C at successive harvests for the four varieties harvested in spring and autumn is presented in Figure 3.

The results in terms of ERS % C have been discussed in detail under the section on ERS % C, but Figure 3 has been included here to link up the tons cane obtained at each harvest with the calculated tons estimated recoverable sugar (ters).

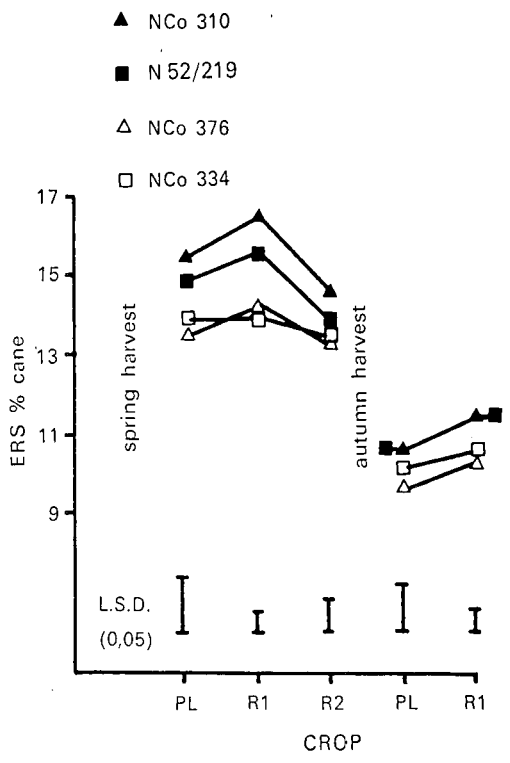


**FIGURE 3** ERS % C at harvest for the plant and ratoon crops of 4 varieties harvested in spring and autumn.

The ters/ha/100 mm effective water, calculated for the four varieties for the plant and ratoon crops of the spring and autumn harvests are presented in Figure 4.

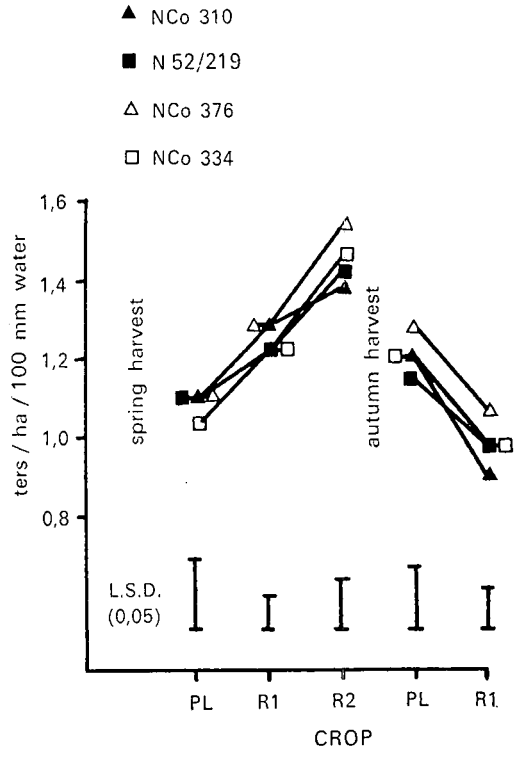


**FIGURE 4** Ters/ha/100 mm effective water for the plant and ratoon crops of 4 varieties harvested in spring and autumn.

The ters/ha for all varieties harvested in spring decreased for the first ratoon and then increased for the second ratoon crops. In terms of ters/ha/100 mm effective water, the same trend was not observed; there was a steady increase in yield with successive ratoon crops. This increase is more linear in terms of ters/ha/100 mm than in terms of tc/ha/100 mm, and is

the result of the higher ERS % C obtained in the first ratoon crop. The trend for the autumn harvest is the same as that for the tons cane yield, viz. the yield was lower in the first ratoon, when compared with the plant crop, for both the ters/ha and ters/ha/100 mm effective water.

In the second ratoon crop of the spring harvest and the first ratoon crop of the autumn harvest, the yield of NCo 376 was statistically significantly greater than that of NCo 310. In all other cases, no statistically significant yield differences were obtained between varieties.

*Third leaf N % d m content*

Third leaf sampling was carried out during the growth of the plant and ratoon crops of both the spring and autumn harvest cycles and the mean results of the third leaf N % d m content are given in Table 3. For the spring harvest the sampling was carried out for sugarcane that was 2 to 5 months old, while for the autumn harvest the sugarcane was 5 to 9 months old.

The data presented in Table 3 indicate that irrespective of the level of the N content in the third leaf, statistically significant differences exist between the varieties.

The ranking of the varieties according to their third leaf N % d m content is relatively consistent, with N7 and N55/805 having higher N contents than NCo 334. NCo 376, N52/219 and NCo 310 fluctuate, but NCo 376 and N52/219 generally have high values and NCo 310 a low value.

The mean of the eight varieties at each sampling was used to demonstrate the effect of age and month of sampling on the third leaf N % d m content of sugarcane grown during spring to spring and autumn to autumn cycles (Figure 5).

In the plant crop of the autumn harvest the N content of the leaves dropped considerably with increasing age up to 7,3 months. After this the N content remained relatively constant at the currently used threshold values. In the ratoon crops of the autumn harvests, the third leaf N content decreased

**TABLE 3**
**The mean 3rd leaf N % d m for the plant and ratoon crops of eight varieties harvested in spring and autumn**

| Rank | Spring Harvest | | | | | | Autumn Harvest | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plant | | 1st ratoon | | 2nd ratoon | | Plant | | 1st ratoon | | 2nd ratoon | |
| | Var | N % d m | Var | N % d m | Var | N % d m | Var | N % d m | Var | N % d m | Var | N % d m |
| 1 | N7 | 2,14 | N7 | 1,68 | 805 | 1,41 | 376 | 2,03 | N7 | 1,78 | N7 | 1,94 |
| 2 | 805 | 1,96 | 805 | 1,64 | N7 | 1,40 | N7 | 2,00 | 805 | 1,73 | 376 | 1,81 |
| 3 | 376 | 1,92 | 376 | 1,64 | 168 | 1,34 | 219 | 1,95 | 376 | 1,72 | 805 | 1,76 |
| 4 | 219 | 1,90 | 168 | 1,63 | 219 | 1,33 | 805 | 1,94 | 168 | 1,57 | 219 | 1,75 |
| 5 | 310 | 1,87 | 219 | 1,62 | 36/14 | 1,32 | 310 | 1,90 | 219 | 1,56 | 310 | 1,72 |
| 6 | 168 | 1,81 | 36/14 | 1,62 | 376 | 1,31 | 168 | 1,84 | 334 | 1,53 | 168 | 1,70 |
| 7 | 334 | 1,76 | 310 | 1,58 | 334 | 1,29 | 36/14 | 1,84 | 36/14 | 1,50 | 36/14 | 1,66 |
| 8 | 36/14 | 1,76 | 334 | 1,46 | 310 | 1,28 | 334 | 1,77 | 310 | 1,49 | 334 | 1,65 |
| CV % | 5,5 | | 5,3 | | 2,7 | | 3,5 | | 3,1 | | 3,7 | |
| 0,05 | 0,12 | | 0,10 | | 0,04 | | 0,08 | | 0,06 | | 0,7 | |
| 0,01 | 0,17 | | 0,14 | | 0,06 | | 0,11 | | 0,08 | | 0,10 | |

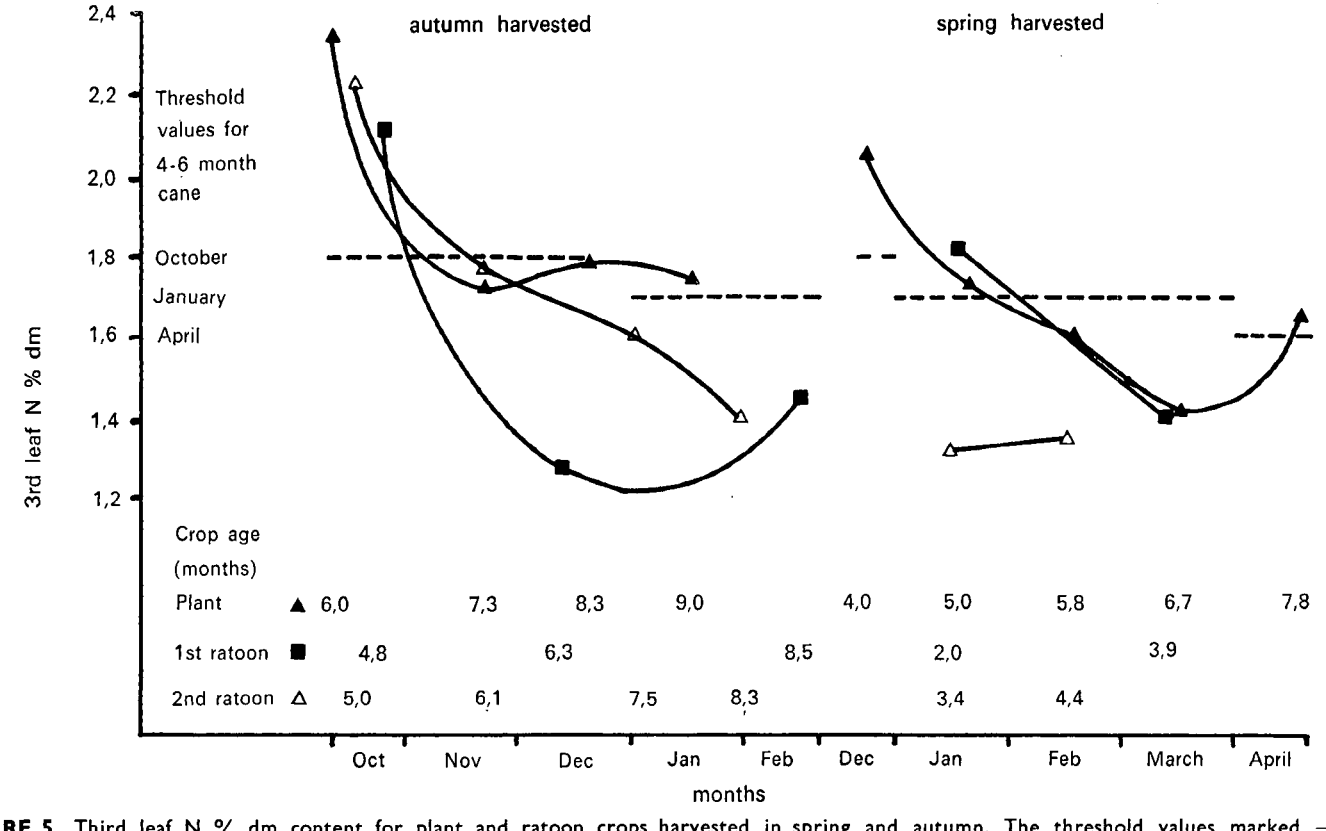


**FIGURE 5** Third leaf N % dm content for plant and ratoon crops harvested in spring and autumn. The threshold values marked ———— are those given by Meyer.[5]

with increasing age, and although it was initially well above the threshold value, it fell below this value at approximately 5 to 6 months of age.

The third leaf N content in the plant crop of the spring harvest was initially greater than the threshold value, but fell below this value at about 5 months of the age. In the first ratoon crop the rate of decrease approximates the rate of decrease in the plant crop, but the N % d m fell below the threshold value at approximately 3 months of age. The third leaf N % d m content obtained for the two samplings taken during the second ratoon crop were extremely low for sugarcane that is 3,5 to 4,5 months old. However, these low values are consistent with those obtained from the first ratoon crop.

## Discussion

The general trend in the ERS % C with time of year is in agreement with the findings of Rostron.[9] The rate of increase in ERS % C is greatest during the months of April and May. It must be stressed that the ERS % C results presented in this paper apply only to sugarcane grown on the Makatini soils series at Pongola and not necessarily to sugarcane grown in other parts of the northern irrigated areas.

In the plant and ratoon crops of the spring harvest and in the first ratoon of the autumn harvest, the ERS % C of NCo 310 is greater than that of NCo 376 and NCo 334. It is primarily for this reason that NCo 310 is a popular variety in the Pongola area, especially as an early season variety. Results obtained for N52/219 indicate that it has an ERS % C that could compete with that of NCo 310. Although NCo 310 is slightly superior to N52/219 in respect of ERS % C in the spring harvest cycle, it performs no better than N52/219 in the autumn harvest cycle. In respect of ERS % C therefore, N52/219 fulfills the requirements of an early season variety.

The yields, in terms of tc/ha/100 mm effective water, indicate that higher yields are obtained from the autumn harvest than the spring harvest. For the autumn harvest the sugarcane is planted in autumn, and because of the relatively mild winters experienced at Pongola it has a full leaf canopy at the beginning of the following summer. It is therefore able to make full use of the summer months for growth before being harvested the following autumn. For the spring harvest, the sugarcane is planted in spring and does not have a full leaf canopy at the beginning of summer. It is therefore unable to make full use of the summer season before being harvested the following spring.

The yield of NCo 376 and NCo 334, in terms of t c/ha/100 mm effective water are consistently greater than those of N52/219 and NCo 310 for both the spring and autumn harvests. This offsets the lower ERS % C obtained for NCo 376 and NCo 334. As a result of this, the yield in terms of ters/ha/100 mm effective water, was much the same for all varieties in the plant and ratoon crops of the spring and autumn harvests. It is interesting to note that NCo 376 yielded statistically significantly more ters/ha than did NCo 310 in both the second ratoon crop of the spring harvest and the first ratoon crop of the autumn harvest.

Observations made during the growth of the crops have shown the presence of smut disease in NCo 310 but not in the other three varieties. In the spring harvest, N52/219 has been found to flower considerably more than NCo 310 and NCo 334. No flowering has been found in NCo 376 in the trials reported.

The third leaf N data indicate conclusively that statistically significant differences do exist between varieties in their foliar N % d m content. Although this difference does exist, the N requirements of the different varieties may not necessarily differ. However, the standard threshold value for N, at present, varies between 1,6% N and 1,9% N depending on crop age, time of year sampled and the area where the cane is grown (Meyer[5]). There is now evidence that allowance should possibly be made for the variety grown.

The data presented in Figure 5 indicate that plant and ratoon cane behave differently with respect to nitrogen uptake in both the spring and autumn harvests. Attention should perhaps be given to this aspect in the determination of threshold values for N.

Moberly[7] noted that the uptake of N was more efficient in crops harvested in spring compared with crops harvested in autumn. The leaf N data presented in this paper do not support this observation. Further, some rather low nitrogen values were obtained with some of the leaf samplings. It would appear that the 'nitrogen story' at Pongola is fairly complex and requires further attention. In applying Beaufils[1] Physiological Diagnosis approach, as modified by Meyer[6] for sugarcane, indices were determined using the N, P and K values from the leaf analysis. It was found that in all cases the high K values had created an imbalance in the nutrient status in the plant. N was indicated to be the most limiting nutrient, even at relatively high values of leaf N. In the determination of threshold values, consideration should possibly be given to the status of other nutrients present in the leaf, such as K, Zn and sulphur.

## Conclusions

Although NCo 310 has a higher ERS % C than NCo 376 and NCo 334, it has not produced higher sugar yields in either the spring or autumn harvests reported in this paper. For this reason, and because it is very susceptible to smut disease, no reason can be found for its continued existence in the Pongola area. The presence of NCo 310 at Pongola is endangering the future of both NCo 376 and NCo 334 as both these varieties can be infected by smut disease. These two varieties, and in particular NCo 376, are the only varieties at present which can be recommended for the Pongola area. This is in agreement with the findings of Rossler.[8]

N52/219 has performed relatively well in the trials, and the planting of this variety in the northern areas should be strongly recommended.

The leaf N data indicate the need to investigate whether different threshold values are required for individual varieties. In the determination of the threshold values, consideration should be given to any possible differences between plant and ratoon cane, and to the status of other nutrients in the plant.

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