# YIELD DIFFERENCES BETWEEN FIVE IRRIGATED SUGARCANE VARIETIES

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### Abstract

The performance of sugarcane varieties NCo376, N14, N19, N22 and N24 grown under irrigation at the SASEX Pongola Research Farm, was compared in terms of cane and sucrose yields. The comparison is based on data from 11 crops (in three experiments) harvested in April/May and from 10 crops (in two experiments) harvested in October/December. In addition to the cane and sucrose yields, data on fibre, moisture and non-sucrose, are reported as yields for better evaluation of the varieties by both grower and miller.

The apportioning of stalk dry matter to its various components differs greatly between presently grown commercial varieties and is a major factor that determines sucrose yields. As an initial step to documenting the differences between varieties, data were presented as the portions of sucrose, non-sucrose and fibre that comprise dry matter in each variety. The data confirm that varieties allocate dry matter differently and that time of harvest has a greater effect on some varieties than on others.

### Introduction

At the time that the sugarcane variety Uba comprised nearly 99% of the South African sugarcane crop (1932-33 season) it was recognised that a range of varieties adapted to the widely different environmental conditions was needed (Dodds, 1938). This was long before sugarcane was being considered for growth in the high potential northern regions. The transfer of the mill from Esperanza to Pongola in 1954 was the beginning of the expansion of the sugar industry into a high potential but semi-arid region. The succession of varieties in the northern irrigated areas has been different to that in the rainfed regions. NCo310 was the dominant variety (91%) in 1967-68 with NCo376 contributing 7,5% to the crop crushed at Pongola (Figure 1). At Malelane the variety mix in its first season (1967-68) reflected the upsurge of NCo376 (55%) in preference to NCo310 (33%) in the rest of the sugar industry (Perk, 1968) (Figure 2). At both the Pongola and Malelane mills NCo376 exceeded 85% of the milled crop in 1979-80 (Lamusse, 1980). During the ensuing years NCo376 was replaced by more smut resistant varieties like N52/219 (14%) and J59/3 (6%) at Malelane, while at Pongola NCo376 still comprised 83% of the crop in 1982-83. At this time N14 was being bulked up and a dramatic increase of the variety was anticipated. During the 1985-86 (Malelane) and 1986-87 (Pongola) harvesting seasons N14 replaced NCo376 as the most widely grown variety in the northern irrigated region. Currently N14 is being replaced by N19 at Pongola, Malelane and Komatipoort, with N25 increasing in popularity at Pongola, and N22, N24 and N25 increasing in popularity at Malelane.

The cyclical transition from one dominant variety to another, as has been witnessed in the past, suggests that N19 is set to become the next dominant variety in the northern areas. With the increase in number of commercial varieties now available in the north, newer varieties could replace N19 relatively soon. This trend will be influenced by the rate of adoption of these varieties by growers. The adoption of these varieties together with N19 can be influenced by comparative yields. Stalk components of five varieties are presented together with their yield data, collected from early and late season experiments, to provide a source from which comparisons can be made. This may facilitate the adoption of the most favourable variety mix. It is acknowledged that these characteristics may only explain some of the differences attributable to varieties. However, in light of the shift to higher productivity and improved quality of the cane delivered to the mills, it is important to know the yield performance of different varieties.

### Methods

The varieties NCo376, N14, N19, N22 and N24 were planted in three experiments (experiments 1, 2 and 3) from which 11 crops were harvested annually in April/May (early season series). These five varieties were common to a late season series of two experiments (experiments 3 and 4) from which ten crops were harvested mostly in December. NCo376 has been included in the comparisons for general interest. The experiments were conducted at Pongola (27°23′S, 31°37′E) on a deep (2,3 m) Hutton, sandy clay soil with an estimated moisture holding capacity of 464 mm (Thompson, 1976). Irrigation was applied by overhead sprinklers delivering 61 mm during a 12 h stand time. The irrigation system at Pongola is designed to supplement rainfall and some stress may have developed particularly at times when water was limited by closure of the canal during its reconstruction. Soil moisture status was estimated using the crop model, IRRICANE (Singels and Kennedy, 1998), which simulates

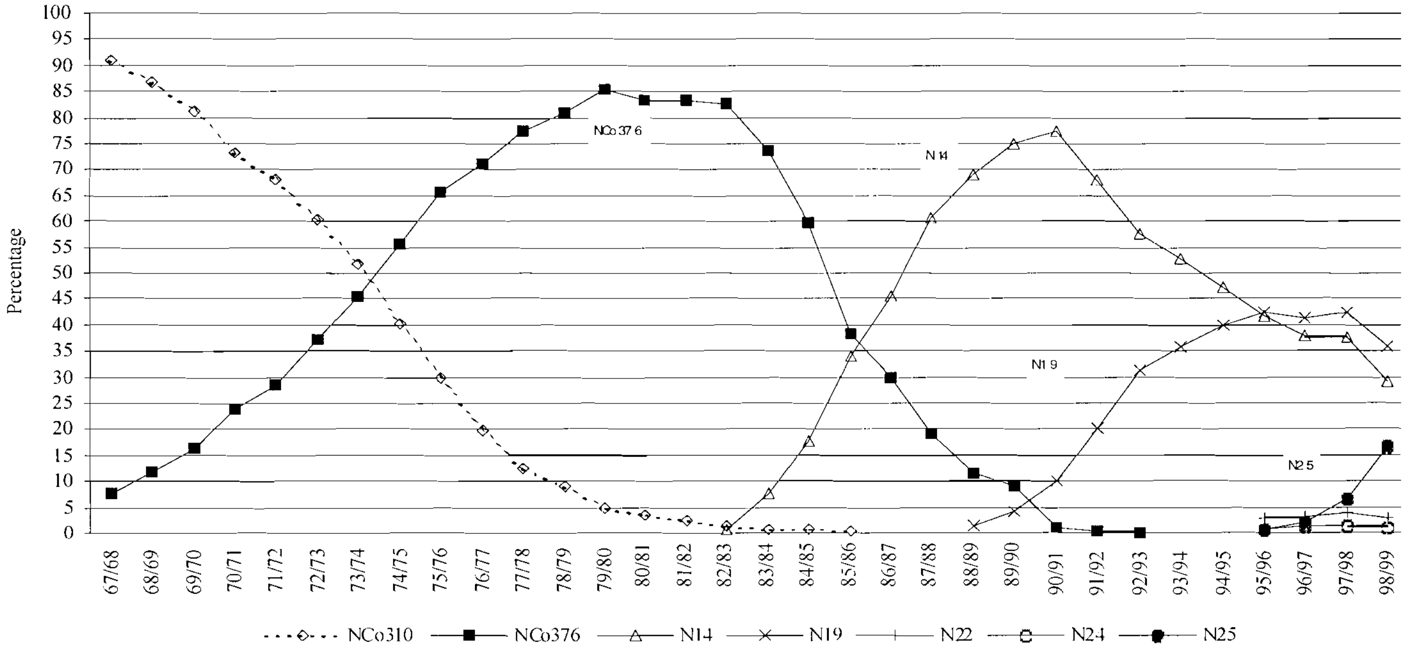


**Figure 1.** Variety statistics for the Pongola mill (% by weight) (data extracted from SASTA proceedings: 1968 – 1999).

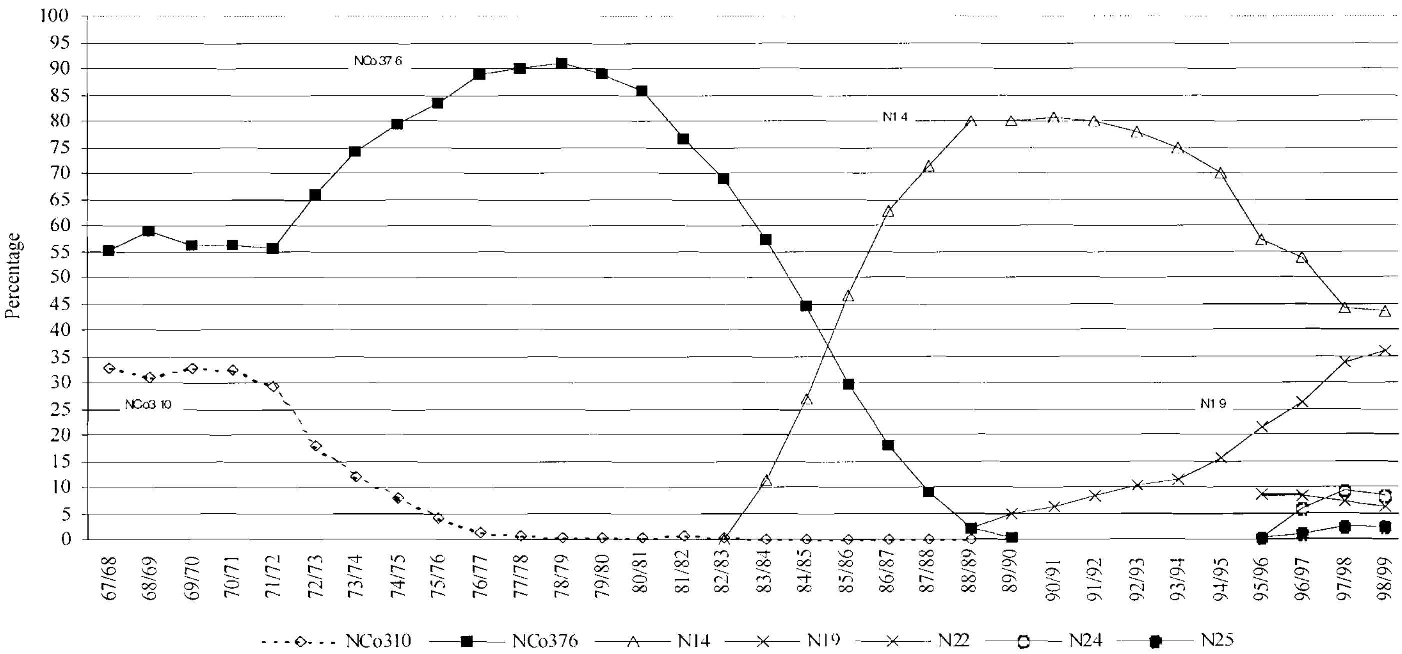


**Figure 2.** Variety statistics for the Malelane sugar mill (% by weight) (data extracted from SASTA proceedings: 1968 – 1999).

canopy development and uses soil water holding characteristics, weather data for the appropriate crop duration and irrigation amounts and dates as inputs. Evapotranspiration figures in Table 1 were derived from the IRRICANE simulation model. Nutrients were applied to satisfy the requirements according to the Fertiliser Advisory Service at Mount Edgecombe for a category 3 soil type (high N mineralising soil) (Table 1). Weeds were suppressed by spraying the combination of Sencor (3 L/ha) and diuron (2 L/ha) at an early stage of crop emergence followed by hoeing when needed. Plots consisted of six rows, 1,4 m apart and 7,5 m long. At harvesting, cane from 6 m of the inner four rows of each plot was weighed and sampled to determine cane quality by direct analysis of cane. Some details of the experiments are presented in Table 1. In experiments 3 and 5, chemical ripening treatments were included. In these experiments only two

**Table 1. Summary of experiment details, fertiliser application and meteorological data.**

| Experiment and trial name | Crop | Crop cycle | Age at harvest (months) | Nutrients applied N:P:K (kg/ha) | Rainfall (mm) (R) | Irrigation (mm) (I) | Evapo-transpiration (Et) | Water deficit (R) + (I) – Et | Radiation (MJ/m²) |
|---|---|---|---|---|---|---|---|---|---|
| Expt1 RVT(NI)15 | Plant | 03/93-05/94 | 13.9 | 220:61:317 | 619 | 549 | 1059 | 109 | 7246 |
| | Ratoon1 | 05/94-05/95 | 11.8 | 131:26:131 | 571 | 427 | 797 | 201 | 6553 |
| | Ratoon2 | 05/95-05/96 | 11.9 | 120:20:200 | 974 | 488 | 1054 | 408 | 6247 |
| | Ratoon3 | 05/96-05/97 | 12.0 | 160:20:160 | 953 | 610 | 1180 | 383 | 6546 |
| Expt2 RVT(NI)17 | Plant | 05/94-05/95 | 13.5 | 103:50:175 | 587 | 549 | 1035 | 101 | 6878 |
| | Ratoon1 | 05/95-05/96 | 11.9 | 120:20:200 | 974 | 183 | 804 | 353 | 6253 |
| | Ratoon2 | 05/96-05/97 | 12.0 | 160:20:160 | 953 | 488 | 1106 | 335 | 6476 |
| | Ratoon3 | 05/97-05/98 | 12.0 | 160:20:160 | 738 | 610 | 1040 | 308 | 6196 |
| Expt3 RVT(NI)19 | Plant | 04/95-05/96 | 12.9 | 99:81:150 | 998 | 488 | 1225 | 261 | 6716 |
| | Ratoon1 | 05/96-05/97 | 12.0 | 160:20:160 | 980 | 976 | 1277 | **689** | **6520** |
| | Ratoon2 | 05/97-05/98 | 12.2 | 117:0:117 | 778 | **1464** | 1186 | **1056** | 6297 |
| Expt4 RVT(NI)14 | Plant | 11/92-10/93 | 10.9 | 139:61:112 | 694 | 671 | 1107 | 258 | 5473 |
| | Ratoon1 | 10/93-10/94 | 12.4 | 113:0:113 | 501 | 488 | 1009 | -20 | 6722 |
| | Ratoon2 | 10/94-10/95 | 11.9 | 144:0:144 | 556 | **427** | 855 | **128** | 6441 |
| | Ratoon3 | 10/95-10/96 | 11.7 | | 963 | **244** | 1001 | **206** | 6143 |
| | Ratoon4 | 10/96-10/97 | 12.2 | 160:0:160 | 1156 | 549 | 1192 | 515 | 6571 |
| | Ratoon5 | 10/97-10/98 | 12.0 | 134:24:126 | 598 | 549 | 1132 | **32** | 6310 |
| Expt5 RVT(NI)16 | Plant | 11/93-11/94 | 12.4 | 139:61:0 | 549 | 610 | 1114 | 45 | 6868 |
| | Ratoon1 | 11/94-12/95 | 12.4 | 153:0:153 | 689 | 549 | 942 | 296 | 6687 |
| | Ratoon2 | 12/95-12/96 | 12.0 | 153:0:153 | 985 | 427 | 1143 | 269 | 6306 |
| | Ratoon3 | 12/96-12/97 | 11.8 | 144:0:144 | 1107 | 671 | 1116 | 662 | 6374 |

**Table 2. Ripener treatments applied to experiments.**

| Experiment | Treatments | Spraying dates | Days from spraying to harvest | Juice purity at time of spraying (%) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | NCo376 | N14 | N19 | N22 | N24 |
| Expt 3 Plant crop | 1.Combination | 23/2/96 | 74 | 59 | 60 | 73 | 62 | 65 |
| | (Ethrel + Fusilade S) | 19/3/96 | 50 | | | | | |
| | 2. Fusilade S | 19/3/96 | 50 | 54 | 60 | 70 | 65 | 65 |
| First ratoon crop | 1.Combination | 14/2/97 | 83 | 70 | 72 | 77 | 75 | 75 |
| | (Ethrel + Fusilade S) | 19/3/97 | 50 | not taken | | | | |
| | 2. Ethrel | 14/2/97 | 83 | 70 | 72 | 77 | 75 | 75 |
| Second ratoon crop | 1.Ethrel | 12/2/98 | 91 | 46 | 53 | 55 | 56 | 51 |
| | 2. Fusilade S | 18/3/98 | 57 | 71 | 82 | 81 | 84 | 82 |
| Expt 5 Plant crop | Fusilade S | 12/10/94 | 49 | 80 | 81 | 83 | 86 | 87 |
| First ratoon crop | Fusilade S | 31/10/95 | 42 | 86 | 86 | 88 | 88 | 90 |

rows were used to determine cane fresh mass yields; the other two were used for sampling. Ethephon was applied at 1,5 L/ha and Fusilade Super at 300 mL/ha. Details relevant to the use of chemical ripeners are shown in Table 2.

## Results

*Yields from early and late season experiments*

Cane and sucrose yields and sucrose contents of the varieties were obtained in each crop for the early and late series experiments. N14 is commonly used as a standard variety in agronomy variety trials in the northern irrigated region. The yield data for N14 are shown in Tables 3 and 4 and the yields of other varieties presented as percentages of N14.

The cane and sucrose yields were then annualised to make for better comparisons between varieties using box plots (Figures 3-5). The box plots show the yield parameters for 11 crops harvested early in the season (experiments 1-3) and

**Table 3. Yield characteristics of varieties expressed as percentages of N14 (actual) in early season experiments.**

| | Cane t/ha | | | | Suc%cane | | | | Suc t/ha | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plant | R1 | R2 | R3 | Plant | R1 | R2 | R3 | Plant | R1 | R2 | R3 |
| Expt 1 | | | | | | | | | | | | |
| RVT(NI)15 | | | | | | | | | | | | |
| N14 | **178** | **133** | **131** | **132** | **11.2** | **9.7** | **10.0** | **8.9** | **19.8** | **12.9** | **13.1** | **11.7** |
| N19 | 97 | 104 | 84 | 95 | 104 | 116 | 113 | 130 | 101 | 120 | 96 | 124 |
| N22 | 106 | 98 | 89 | 95 | 108 | 136 | 122 | 133 | 115 | 133 | 109 | 126 |
| N24 | 92 | 92 | 83 | 97 | 113 | 141 | 131 | 134 | 105 | 129 | 109 | 132 |
| NCo376 | 106 | 115 | 98 | 100 | 96 | 116 | 101 | 103 | 102 | 135 | 99 | 103 |
| SED | 4 | 4 | 3 | 4 | 7 | 9 | 5 | 7 | 8 | 9 | 5 | 8 |
| Expt 2 | | | | | | | | | | | | |
| RVT(NI)17 | | | | | | | | | | | | |
| N14 | **174** | **144** | **141** | **104** | **11.6** | **9.7** | **11.2** | **12.7** | **20.1** | **13.9** | **15.7** | **13.2** |
| N19 | 95 | 86 | 87 | 93 | 102 | 121 | 107 | 105 | 98 | 104 | 94 | 97 |
| N22 | 80 | 78 | 80 | 90 | 105 | 118 | 103 | 108 | 84 | 91 | 84 | 97 |
| N24 | 86 | 74 | 84 | 86 | 114 | 133 | 114 | 119 | 99 | 99 | 95 | 102 |
| NCo376 | 98 | 96 | 103 | 102 | 106 | 100 | 94 | 100 | 103 | 96 | 97 | 102 |
| SED | 4 | 5 | 6 | 7 | 7 | 5 | 7 | 3 | 7 | 7 | 9 | 6 |
| Expt 3 | | | | | | | | | | | | |
| RVT(NI)19 | | | | | | | | | | | | |
| N14 | **161** | **162** | **99** | | **11.3** | **12.0** | **10.9** | | **18.2** | **19.3** | **10.9** | |
| N19 | 97 | 79 | 82 | | 124 | 114 | 110 | | 119 | 90 | 89 | |
| N22 | 84 | 89 | 92 | | 112 | 113 | 107 | | 94 | 101 | 98 | |
| N24 | 77 | 98 | 100 | | 128 | 129 | 127 | | 99 | 128 | 125 | |
| NCo376 | 102 | 94 | 91 | | 106 | 98 | 95 | | 107 | 92 | 85 | |
| SED | 4 | 5 | 6 | | 8 | 5 | 7 | | 10 | 8 | 12 | |

**Table 4. Yield characteristics of varieties expressed as percentages of N14 (actual) in late season experiments.**

| | Cane t/ha | | | | | | Suc%cane | | | | | | Suc t/ha | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plant | R1 | R2 | R3 | R4 | R5 | Plant | R1 | R2 | R3 | R4 | R5 | Plant | R1 | R2 | R3 | R4 | R5 |
| Expt 4 | | | | | | | | | | | | | | | | | | |
| RVT(NI)14 | | | | | | | | | | | | | | | | | | |
| N14 | **108** | **119** | **94** | **99** | **143** | **97** | **14.5** | **15.5** | **14.0** | **14.0** | **14.3** | **15.1** | **15.6** | **18.4** | **13.2** | **13.9** | **20.4** | **14.6** |
| N19 | 112 | 99 | 105 | 96 | 100 | 88 | 102 | 96 | 93 | 109 | 103 | 109 | 114 | 94 | 98 | 105 | 103 | 96 |
| N22 | 96 | 87 | 85 | 81 | 104 | 91 | 100 | 100 | 100 | 103 | 100 | 106 | 96 | 87 | 84 | 83 | 104 | 96 |
| N24 | 101 | 99 | 81 | 71 | 106 | 103 | 108 | 106 | 114 | 110 | 103 | 111 | 109 | 105 | 92 | 79 | 109 | 114 |
| NCo376 | 112 | 100 | 94 | 77 | 111 | 109 | 97 | 89 | 99 | 101 | 95 | 98 | 108 | 89 | 93 | 78 | 105 | 106 |
| SED | 4 | 6 | 5 | 4 | 4 | 4 | 3 | 4 | 6 | 3 | 3 | 3 | 5 | 8 | 9 | 5 | 4 | 4 |
| Expt 5 | | | | | | | | | | | | | | | | | | |
| RVT(NI)16 | | | | | | | | | | | | | | | | | | |
| N14 | **150** | **124** | **137** | **123** | | | **11.7** | **13.2** | **13.2** | **13.4** | | | **17.5** | **16.4** | **18.0** | **16.3** | | |
| N19 | 84 | 106 | 100 | 96 | | | 116 | 104 | 117 | 102 | | | 97 | 111 | 116 | 98 | | |
| N22 | 83 | 90 | 97 | 103 | | | 108 | 103 | 109 | 113 | | | 90 | 93 | 105 | 116 | | |
| N24 | 88 | 117 | 86 | 105 | | | 124 | 104 | 125 | 111 | | | 110 | 121 | 108 | 117 | | |
| NCo376 | 95 | 99 | 97 | 114 | | | 97 | 90 | 97 | 98 | | | 92 | 90 | 95 | 112 | | |
| SED | 8 | 11 | 8 | 9 | | | 8 | 6 | 6 | 5 | | | 13 | 15 | 9 | 8 | | |

10 crops harvested late in the season (experiments 4 and 5) for each of the five varieties (SYSTAT® 6.0 for Windows: Graphics). The box represents the middle 50% of the data set. The horizontal line within the box marks the median of the data. The vertical lines above and below the box show the distribution of the upper and lower 25% of the data, respectively. The outer extremes of the vertical lines mark the maximum and the minimum values in the data. Values that fall beyond the outer extremes are shown as outliers.

*Sucrose yields*

Overall varieties yielded between 0,2 and 1,3 tons of sucrose

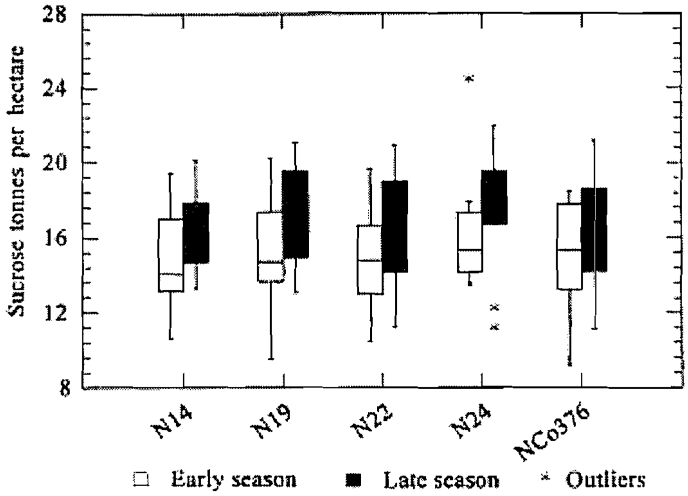


**Figure 3.** Sucrose yields (t/ha/annum) of five varieties harvested early and late season.

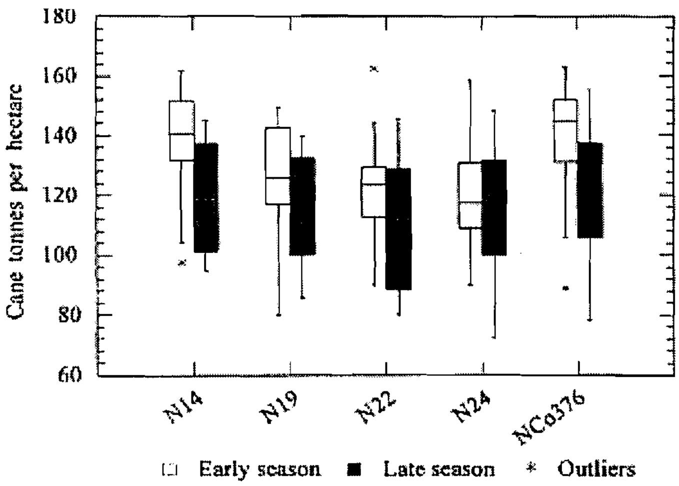


**Figure 4.** Cane yields (t/ha/annum) of five varieties harvested early and late season.

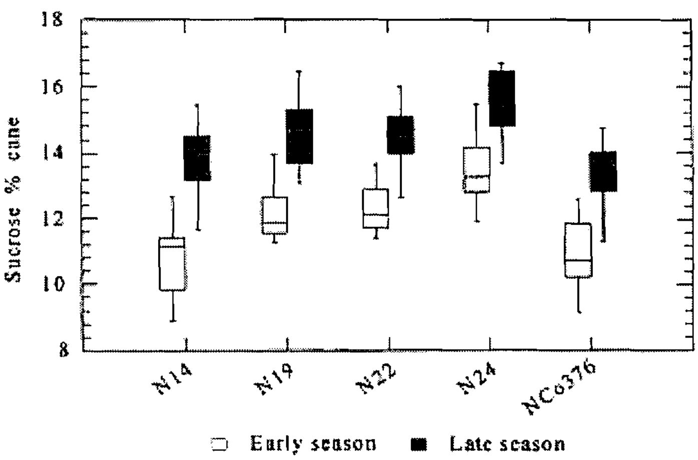


**Figure 5.** Sucrose % cane of of five varieties harvested early and late season.

more when harvested late in the season (Oct-Dec) (Figure 3 and Table 5). Differences between varieties became more noticeable in the late season when N24 yielded better than the other varieties. The median yields of N22 and NCo376 were similar in both the early and late series experiments.

All varieties yielded poorly in experiment 3, ratoon two (Table 3). The lowest early season sucrose yields for each of the varieties were obtained in this ratoon crop and are shown in the box plots as the lowest point on each line. This was mainly due to waterlogged soil during the first 150 days of the crop. Sucrose yields of N24 seemed to be least affected by these conditions while those of N19 and NCo376 were particularly poor. This may indicate differences between these varieties in their tolerance to waterlogging. The low sucrose yields in the second ratoon are in strong contrast to those of the plant and first ratoon crops in experiment 3, which were particularly high for N24 in the first ratoon.

The low yields in the second and third ratoons of experiment 4 (Table 4) were caused by stress that developed from not applying sufficient irrigation water (Table 1). The lowest yields obtained in the late season experiments were better than the lowest yields obtained in the early series experiments, except in the case of N24. N22, N24 and NCo376 yielded poorly in these drier conditions relative to N19 and N14 (Table 3). Varieties however, yielded no differently when conditions were conducive to high yields, as was the case in the fourth ratoon of experiment 4.

*Cane yields*

Cane yields of N14 and NCo376 were higher than the other varieties in the early season (Figure 4). While the cane yields of N19, N22 and N24 were lower than N14 and NCo376, the differences between varieties were small in the late season experiments.

*Sucrose content of fresh cane mass*

Varieties had distinctly higher sucrose contents (+2.4 % units) in the late than in the early season experiments (Figure 5). The higher sucrose yields obtained in the late season are mainly attributable to this higher cane quality. N19 and N22 had higher sucrose contents than N14 and NCo376 in the early season experiments and not in the late season. At all times the sucrose content of N24 was substantially higher than that of the other varieties.

*Ratooning ability of varieties*

Cane yields of varieties were annualised (data not shown) and compared over ratoon crops to determine the ratooning ability of these varieties. No trends could be established for any of these varieties. The genetic component of ratooning ability was overshadowed by the influences of weather and water stress.

*Stalk components of varieties*

The mean values of the stalk components are presented in Tables 5 and 6 and Figure 6. It is of interest to consider the amount of moisture in the cane at the time of harvest as this

**Table 5. Stalk components of varieties expressed as percentages of cane mass and sucrose yields for early and late series experiments.**

| Component | NCo376 | | N14 | | N19 | | N22 | | N24 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late |
| Cane mass t/ha | 142 | 121 | 142 | 119 | 129 | 117 | 126 | 110 | 125 | 115 |
| Sucrose t/ha | 15.6 | 16.0 | 15.3 | 16.4 | 15.7 | 17.0 | 15.6 | 15.8 | 16.9 | 17.7 |
| Fibre % cane | 10.5 | 13.7 | 9.8 | 12.7 | 10.9 | 13.4 | 10.2 | 12.7 | 10.0 | 12.3 |
| Non-suc % cane | 2.5 | 1.9 | 2.4 | 1.9 | 2.2 | 1.8 | 2.3 | 1.8 | 2.0 | 1.6 |
| Sucrose % cane | 11.0 | 13.3 | 10.8 | 13.9 | 12.2 | 14.6 | 12.4 | 14.4 | 13.6 | 15.5 |
| Moisture % cane | 76.1 | 71.1 | 77.0 | 71.5 | 74.7 | 70.2 | 75.2 | 71.1 | 74.4 | 70.6 |

stalk component can contribute between 70 and 76% towards the overall mass of the cane that is transported to the mill. These experiments indicated clearly that the **moisture component** of the cane harvested in the early season experiments was distinctly higher, with a wider range, than for the late season experiments (Table 5). In the early season the mass of the moisture components in NCo376, N14 and N24 were 108, 109 and 93 tons per hectare, respectively (Figure 6). Late in the season, differences between varieties were relatively small with the mass of the moisture component in N22 amounting to 78 tons per hectare.

Dry matter yields of N14, N19 and N24 are higher in the late season and were not different in the early and late series for NCo376 and N22 (Table 6). The water insoluble part of cane, known as true **fibre**, constituted a greater portion of the stalk dry matter yield late in the season. At both times of harvesting, the fibre contents were highest in NCo376 and lowest in N24. There was a higher portion of non-sucrose in the stalks harvested early in the season. Generally, NCo376 and N14 had highest, and N24 had the lowest, ***non-sucrose*** content. The fraction of **sucrose** in the stalk dry matter (sucrose % DM) was slightly higher in the late season for N14, while differences between seasons were insignificant in other varieties. N24 had significantly more (between 3 and 7 %units) sucrose than the other varieties with NCo376 having the lowest for both seasons.

*Variety characteristics as a percentage of N14*

When new varieties are selected for release into the South African sugar industry, it is necessary to make comparisons

**Table 6. Stalk dry mass (t/ha) of varieties and components expressed as percentages of dry mass for early and late series experiments.**

| Component | NCo376 | | N14 | | N19 | | N22 | | N24 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late |
| Dry Mass t/ha | 34.1 | 34.9 | 32.6 | 34.0 | 32.7 | 34.9 | 31.3 | 31.8 | 31.9 | 33.7 |
| Fibre % dm | 43.8 | 47.2 | 42.4 | 44.7 | 43.1 | 45.0 | 41.0 | 44.0 | 39.0 | 41.9 |
| Non-suc % dm | 10.4 | 6.7 | 10.6 | 6.5 | 8.7 | 6.1 | 9.2 | 6.1 | 8.0 | 5.4 |
| Sucrose % dm | 45.8 | 46.1 | 47.0 | 48.8 | 48.2 | 48.9 | 49.8 | 49.9 | 53.0 | 52.7 |

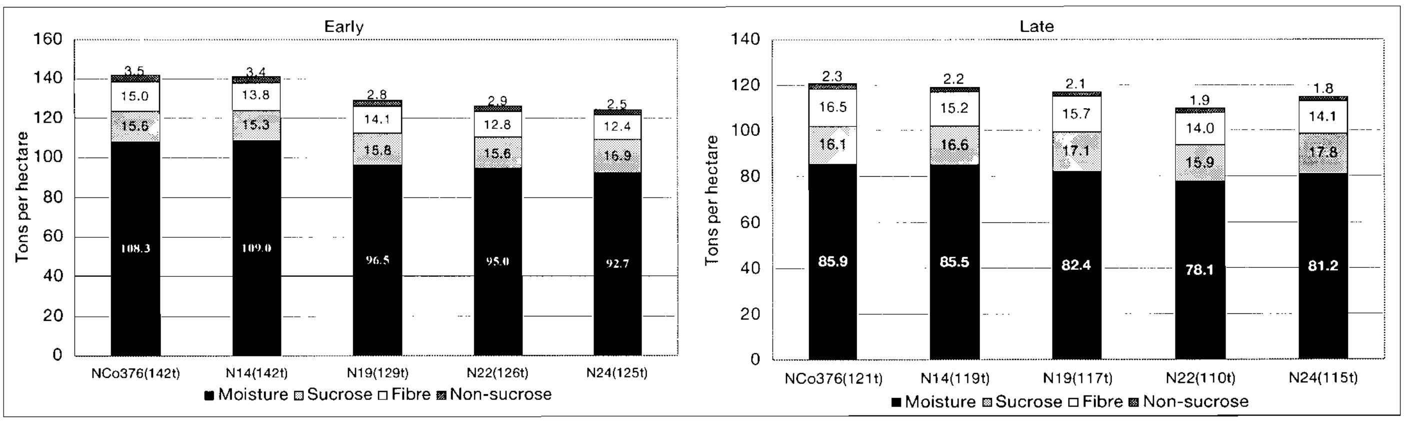


**Figure 6.** Stalk components of varieties for early and late season experiments, expressed as tons per hectare.

between them and a standard variety that is commonly grown in a particular region. Therefore, yield characteristics for sucrose and fibre, expressed as percentages of dry matter and juice purities for early (Figures 7) and late (Figures 8) season experiments of the newer varieties are expressed relative to N14.

In the **early season** experiments NCo376 had a lower sucrose content and juice purity with a higher fibre content than N14 (Figure 7). The slightly higher sucrose content of N19 was associated with a slightly higher fibre content and higher juice purity. There were substantially higher sucrose contents and juice purities with lower fibre contents in N22 and N24. N19, N22 and N24 had higher juice purities than NCo376 and N14.

In the **late season** experiments all components of dry matter were smaller (relative to N14) than in the early series (Figure 8) except for NCo376, which had a slightly higher fibre content later in the season. The trends were essentially the same as in the early season experiments.

*Effects of ripeners*

Treatments, dates of spraying, interval from spraying to harvesting and juice purities from cane stalks sampled at spraying are shown in Table 2.

*Late season – experiment 5*

The plant and first ratoon crops of experiment 5 were sprayed during the second and last weeks of October, respectively. The condition of the cane on both occasions was considered unsuitable for chemical ripening. The cane samples taken on the days of spraying had juice purities of 80 to 90%, which is considered too high to elicit good responses (Rostron *et al*, 1986). This was confirmed by the small improvements in sucrose content of samples taken 49 and 42 days after spraying (data not shown). No chemical ripening was attempted on the remaining ratoons in this experiment.

*Early season – experiment 3*

In the **plant crop**, both Fusilade Super alone and the combination treatment raised the sucrose contents of NCo376 and N22 by more than 1 percentage unit (Figure 9). The responses to the combination treatment were generally no better than from Fusilade Super alone. Simulation of moisture in the soil suggests that the crop was subjected to mild stress between 140 and 240 days after ratooning. Thereafter, soil moisture was restored to levels that were generally adequate to avoid prolonged stress. The decline in purity between the time of spraying ethephon (74 days before harvesting) and the time that Fusilade Super was applied (50 days before harvesting) (Table 2) may have been a response to the improved soil moisture status following a period of stress. Cane yields were reduced by both ripener treatments such that there was no benefit in terms of sucrose yields from the improved sucrose content of NCo376. In contrast to NCo376, results indicated that cane yields were higher in Fusilade Super

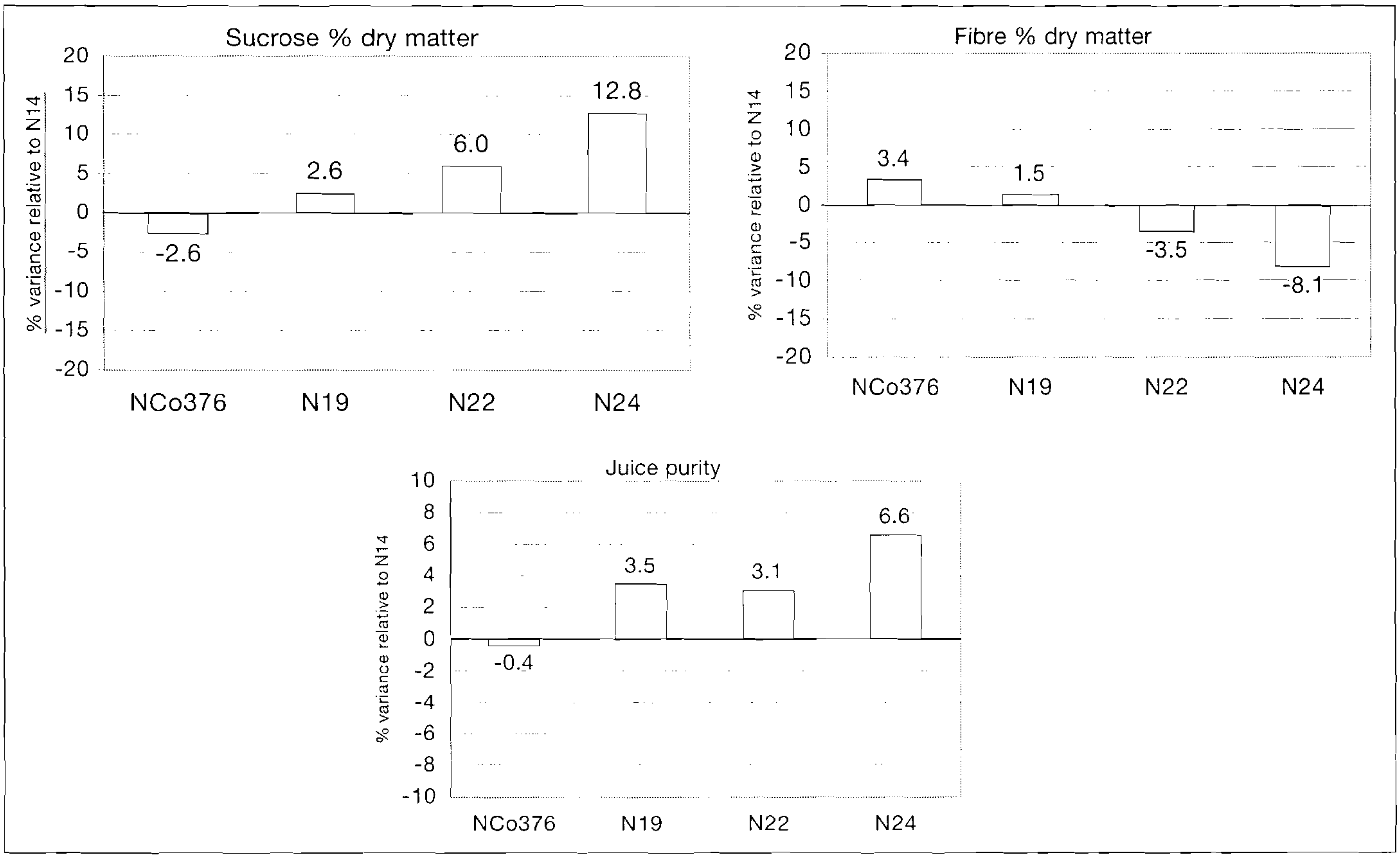


**Figure 7.** Sucrose and fibre content as a percentage of dry mass, and juice purity relative to N14 for early season experiments.

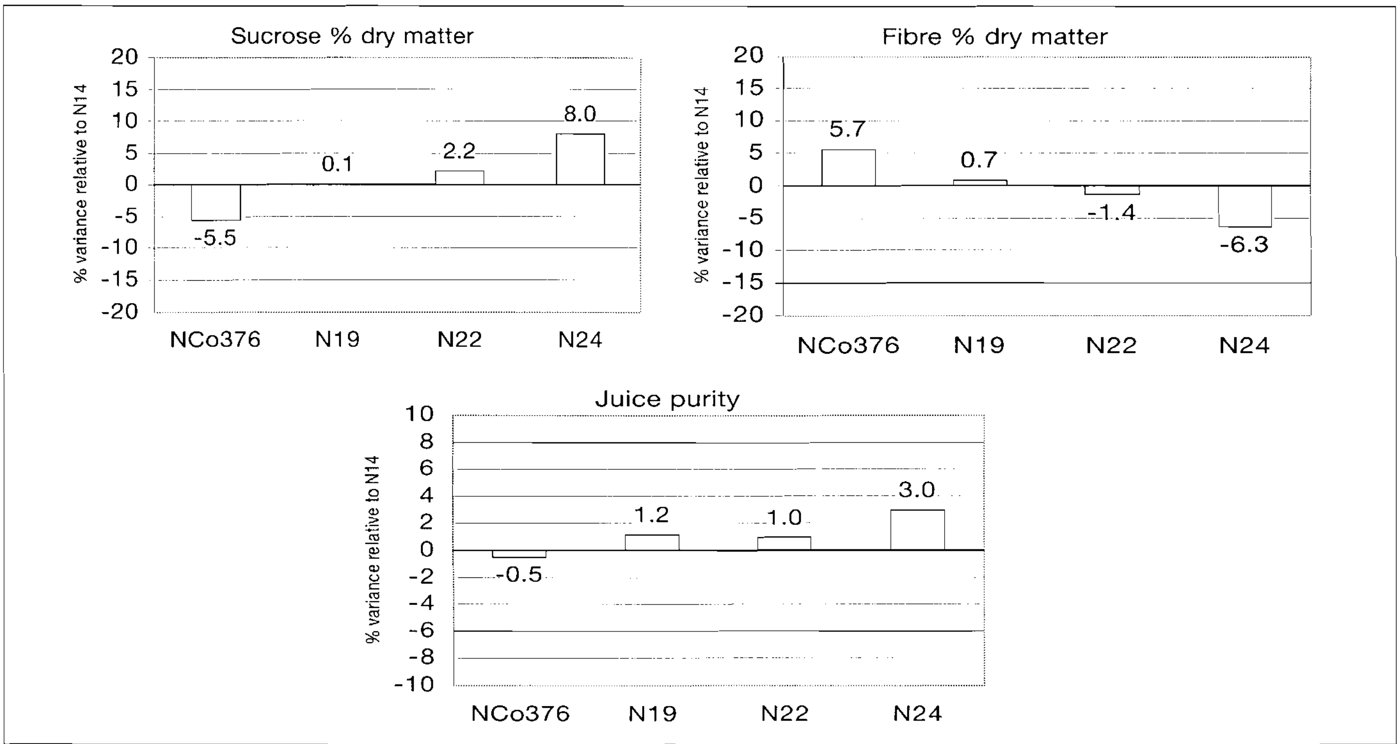


**Figure 8.** Sucrose and fibre content as a percentage of dry mass, and juice purity relative to N14 for late season experiments.

treated plots of both N14 (P=0.05) and N24. It is not known whether these higher cane yields were due to the ripener application. These higher cane yields, however, together with the relatively small improvements in sucrose content raised the sucrose yields in these two varieties.

For the duration of the **first ratoon**, soil moisture status was adequate, and the relationship between total sunlight radiated and cane yields was similar for the plant and first ratoon crops (Table 1). Sucrose content was raised by more than one percentage unit in response to ethephon only in NCo376 and N22. With the exception of N24, the combination treatment elicited better responses than ethephon alone. This was particularly marked in NCo376. Much of the potential gains in sucrose yields from the effect on sucrose content were negated by cane yield reductions caused by the ripener treatments. The exception to this was NCo376 in which sucrose yields were raised by 2,7 ± 1,6 (15%) and 4,2 ± 1,6 (24%) tons per hectare in response to ethephon and the combination treatment, respectively. Sucrose yields were severely reduced (by 5 ± 1,6 tons per hectare) (20%) by both ripener treatments, due to depressed sucrose content and loss of cane yields in N24.

Ethephon had little effect on sucrose content in the **second ratoon** and is in contrast to the large responses (P=0,01) from Fusilade Super. The negative effect that Fusilade Super had on cane yields (data not shown) was less severe on NCo376, N14 and N19 than on N22 and N24. The combined effects on sucrose contents and cane yields were such that gains in sucrose yield were only close to statistical significance (P=0,05) for NCo376. Sucrose yields of N22 and N24 were reduced (P=0,05) by Fusilade Super. As in the first ratoon crop, ethephon reduced sucrose yields of N24 (P=0,05).

## Discussion

Sucrose yields of NCo376, N14, N19, N22 and N24 differ when they are harvested late in the season (up to December). When harvested early in the season these differences in sucrose yields become less pronounced. Although differences between sucrose yields were generally small, the proportions of the stalk components varied significantly. These stalk components are of economic importance to both the grower and miller.

Stalk dry mass yields and sucrose yields were shown to be lower in the early than in the late season series of experiments. Despite the lower dry mass, cane yields were higher in the early season because of the higher moisture component. The moisture component is therefore largely responsible for the higher transport costs of early harvested cane. In the early season the lower fibre content of the dry cane mass may favour better extraction of sucrose while the lower juice purity at this time will detract from the recovery of the sucrose. Some of the shortcomings of these factors in the early season can be partly corrected through the adoption of varieties like N22 and N24 and the use of chemical ripeners.

Although ripeners will generally improve cane quality, it is known that varieties respond differently to ripeners. The yield reductions from applying ethephon to N24 were unexpected and further investigation is needed. Fusilade Super

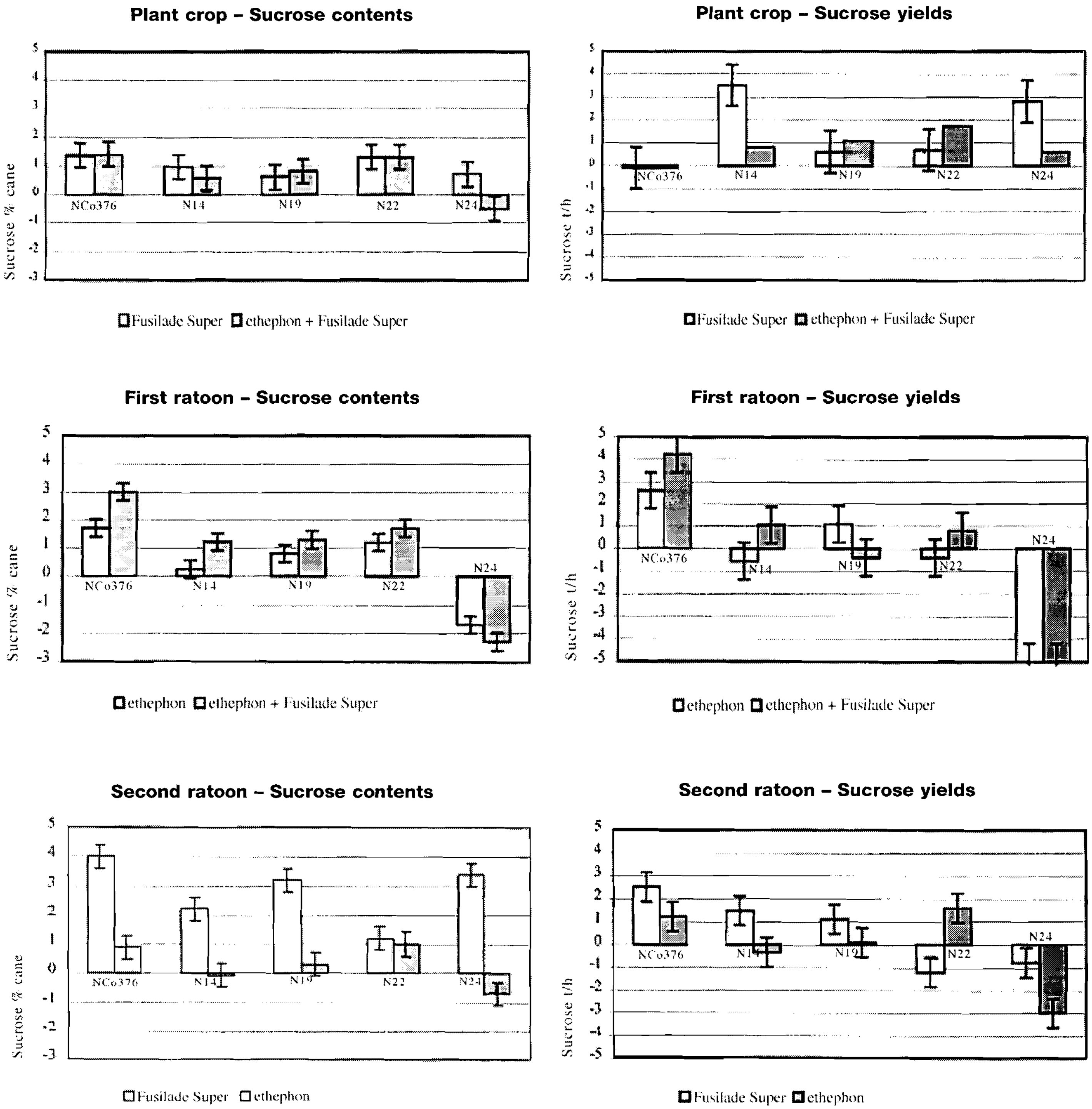


**Figure 9.** Effects of ripener treatments on sucrose content and sucrose yields in three crops of experiment 3 (bars indicate standard errors).

increased the sucrose content of all varieties. However, sometimes there was either little or no increase in sucrose yields because of the negative effect the ripener had on cane yields. This may have been caused by the incorrect time interval between spraying and harvesting for some varieties.

Varieties like N14 and NCo376, because of high cane yields incur higher harvesting, loading and transport costs. Varieties that have equivalent sucrose yields from a lower cane mass like N19, N22 and N24 should be of greater economic value to both grower and miller. The yield characteristics of N14 improve relative to the other varieties when harvested later in the season and confirm that N14 is better suited to harvesting in the mid to late part of the season. Other similar experiments have shown, however, that when flowering is profuse, yields of N14 may be reduced when harvested after October. Besides the known effects of smut on NCo376 this variety also had higher fibre content and lower sucrose % DM than N14.

When varieties were compared in terms of sucrose yields and the above mentioned stalk components, N24 proved to be far superior in terms of economic value for both miller and grower. It is important to note that this variety does have some unfavourable traits that have not been dealt with in this paper. These include a tendency to lodge which increases harvesting costs and an open growth habit that makes weed control difficult.

An attempt was made to determine the ratooning ability of these varieties over a number of crops. These experiments indicated that the influence of the weather and the presence or absence of water stress in a crop, far outweighed any possible genetic differences these varieties may have had in terms of their ratooning ability.

Factors that have not been considered in this paper include herbicide costs related to growth habit, harvesting costs, tendency to lodge, distance from the mill and disease susceptibility of a variety. These factors may detract from the adoption of a variety regardless of its yield characteristics.

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