EVALUATING A NEW VARIETY (N11) IN SEEDCANE INCREASE PLOTS BY MEANS OF A SAMPLE HARVEST METHOD

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Abstract

A sample method of yield estimation is described and this was used to determine cane yields in seventeen seedcane increase plots of the new variety N11. Yields were also estimated in adjacent plots of NCo 376 which had been planted at the same time. The estimated yield of N11 from these plots was compared with the evaluation of the variety in selection trials before release. The yield of N11 at each site was plotted against an estimate of potential yield derived from the yield of NCo 376. The regression coefficient was calculated from these data and using the slope of the regression line to indicate varietal adaptability at different yield potentials, N11 was seemingly a stable variety. However, the comparison should be extended into ratoon crops to determine yield stability satisfactorily.

Introduction

The release of a new sugarcane variety is the culmination of many years of selection and evaluation in yield and disease resistance trials. By the time a new variety is released from the selection programme at Mount Edgecombe it has been tested for approximately 14 years and yields have been determined in nine separate replicated variety trials, situated throughout the cane belt. There is therefore some indication of the suitability of a new variety to different growing conditions from these trials. However, when a new variety is sent out to co-operating growers for seedcane bulking it is simultaneously planted at 30 to 40 sites throughout the South African cane growing areas. These plots are not only useful venues where the performance of the new variety can be discussed with growers, but at the same time they can be used to study the growth of the variety over a wide range of conditions and management.

Co-operators planting seedcane increase plots (SIPs) of N11 were asked to plant at the same time a plot of the established variety NCo 376 next to the new variety. The yields of the two plots could then be estimated, using sample harvest techniques, and these results could be used to determine the yield relationship between N11 and NCo 376. In addition, there existed a possibility of obtaining an indication of the yield stability of the new variety using these data. The basis for this assessment was the technique used by Finlay and Wilkinson[4] to study the yielding ability of barley varieties over a range of environments. They used the mean yield of all the varieties tested in each trial to give a measure of the environment where the trial had been conducted. The individual variety yields were then compared with this figure and the regression coefficient calculated. They reasoned that a variety with an average response to the environment would have a regression coefficient of one. A variety that responded particularly to a good environment would be indicated if the regression coefficient were greater than one. A variety for which the regression coefficient was less than one was apparently adapted to a low yielding environment. Pollock[6] applied a similar method to sugarcane, using the analysis of variance discussed by Eberhart and Russell[3] to study the stability of standard cane varieties used in variety trials in Australia. More recently Ruschel[7] has analysed the data from variety trials carried out by the Campos Experiment Station in the state of Rio de Janeiro in Brazil. He was able to illustrate that the variety CB 45-3 showed an unusual stability over the environments studied when assessed in these terms, and considered that the general acceptance of this variety in Brazil was evidence of this yield stability.

Method

The method considered for the evaluation of N11 in the seedcane increase plots, was based on the yield of NCo 376 as an estimate of environmental potential. The use of the yields of a single variety as a measure of the environmental potential clearly suffers from the disadvantage that the measurement will be influenced by the specific behaviour of that variety. However, since NCo 376 is known to be a very widely adapted variety, it was felt that this influence might be small.

A check on the proposed method of comparison was made using data from varieties already tested in the selection programme. L76 and CP43/64, two introduced varieties which had been judged to respond to good environments were compared with NCo 376 in the same trials. In addition N55/805, which by virtue of its good performance on sandy soils might be considered to be adapted to poor environments, was compared with NCo 376 in 13 agronomic trials.

The individual trial yields for the test varieties were then compared with an estimate of the environmental potential derived from the yield of NCo 376, and the regression coefficients calculated for each variety. (See Table 1.) The estimate of environmental potential for each trial site was obtained by adjusting the NCo 376 yield according to the following formula:

$$Xa_1 \ldots . n = X_1 \ldots . n \left(\frac{\bar{y}}{\bar{x}}\right)$$

where $Xa_1 \ldots . n$ = Estimate of potential yield for each of n sites.

$X_1 \ldots . . n$ = Yield of NCo 376 at each of n sites.

$\bar{x}$ = mean yield of NCo 376 for all sites.

$\bar{y}$ = mean yield of test variety for all sites.

This adjustment expresses the site yield potential in terms of the test variety and thus avoids the comparison of varieties with widely differing mean yields. Since varieties are likely to show proportional rather than constant yield differences at various yield levels, it was considered more realistic to compare the regression line slope where an adjustment for level of yield had been made.

TABLE 1

Correlation and regression coefficients derived from a regression analysis of variety yield and NCo 376 yield in selection trials

Variety	Correlation coefficient (r)	Regression coefficient (b)	S.E. of Regression
CP 43/64	0,96	1,17	± 0,102
L76	0,95	1,16	± 0,089
N55/805	0,96	0,95	± 0,076
N11 (Selection trials)	0,94	1,07	± 0,093

The coefficients for L76 and CP 43/64 were greater than one and the observation that these varieties responded well to good environments was thus supported. The coefficient for N55/805 was less than one, and although not significantly so, this result is in keeping with the general observations concerning the variety. The coefficients for N11 calculated from selection trial data have also been included in the table.

Estimation of cane yield

Thirty-three co-operators were supplied with seedcane of the variety N11 in September 1977. Seventeen of these sites were chosen for study because of satisfactory germination and the presence of an adjacent plot of NCo 376 which could be used for comparison. Cane yields were estimated during the following winter using a sample method developed by Bechet,[2] in which it is assumed that the stalk is cylindrical:

$$\text{Volume} = \pi r^2 h \quad \text{cm}^3$$

$$= \frac{\pi d^2 h}{4} \quad \text{cm}^3$$

where r = radius in cm
d = diameter in cm
h = length in cm.

From volume and mass determinations carried out in a variety trial the average stalk density was determined as 1,06 gcm^{-3}. This figure agrees with water displacement determinations of stalk density carried out by Miller and James.[5] Mass cane may therefore be determined as follows:

$$\text{mass} = \frac{n\,(\pi \times 1.06)\,d^2 h}{4} \quad \text{g}$$

$$\text{Since } \pi \times 1.06 = \frac{10}{3},$$

$$\text{mass} = \frac{n \times 10 \times d^2 \times h}{3 \times 4} \quad \text{g/ha}$$

$$= \frac{n \times d^2 \times h}{1{,}2 \times 10^6} \quad \text{tons/ha}$$

where n = stalk population per hectare.

Bechet[2] originally developed this formula to estimate the mass of single stools in the plant breeding programme. For this purpose he showed that, if stalk length were measured in feet (1 foot = 30 cm), then the yield could be determined as:

$$\text{mass} = \frac{n\,d^2 h}{4 \times 10} \quad \text{kg}$$

The number of stalks per hectare in each plot was estimated from counts made in two-metre sample row lengths. Twenty samples were taken at random in each plot. The height of cane was measured in the same sample positions and the average length of stalk below the estimated topping point was measured. The diameters of a number of stalks at each sampling site were measured in the standing cane, using a special V-gauge (Fig. 1), which was graduated directly in units of diameter squared (d^2).

Two samples, each made up of 15 stalks, were taken from each plot for sucrose analysis. The samples were taken from what were considered to be average areas of the plot, deliberately avoiding very good or very poor areas. The sample was also used to determine the mean mass of a single stalk. This figure multiplied by the population estimate gave a second determination of yield which showed a good correlation with the volume method of yield estimation (r = 0,86).

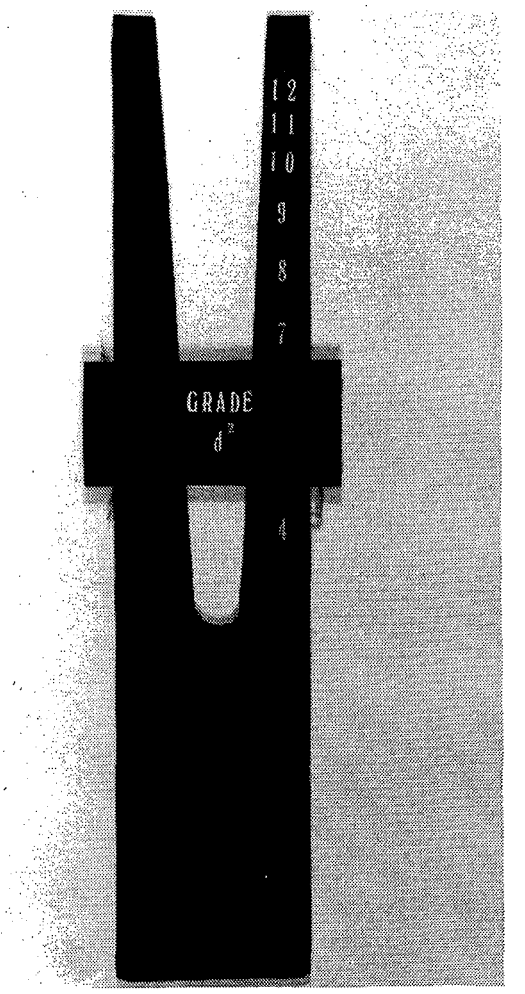

FIGURE 1 Special V-gauge for measuring diameter.

Results

In the course of making the yield estimates it was noted that profuse flowering had occurred in N11 at nearly all of the sites. Conditions in 1978 may have favoured flowering, which was rather more abundant than had been noticed during the earlier stages of selection of the variety.

N11 stalks were consistently taller and thicker than those of NCo 376, averaging 1,5 m in height and 2,4 cm in diameter, while the comparable figures for NCo 376 were 1,4 m and 2,2 cm respectively. The stalk population of N11 was 94 000 compared to 128 000 for NCo 376.

The average estimated yields of cane and sucrose are shown in Table 2. The figures given are averages for all the sites studied, and are similar to the assessment of the variety made in 1977[1] from selection trials.

TABLE 2

The average yield of N11 and NCo 376 determined from yield estimates in seed bulking plots

Variety	Cane yield, tons/ha	Pol % cane	Mass pol as % NCo 376
NCo 376	88	11,9	100
N11	81	13,7	105

The cane yield of N11 at each of the 17 sites was plotted against an estimate of environmental potential for each site derived from the yield from the NCo 376 plot (see Fig. 2). The coefficients of correlation and regression calculated from

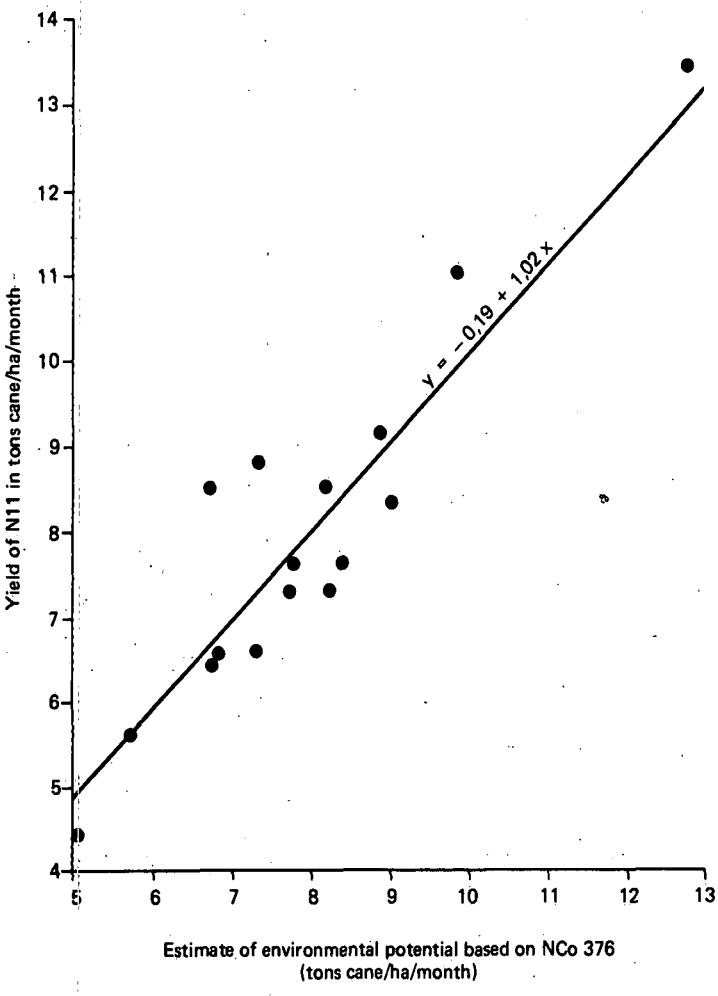

FIGURE 2 Cane yield of N11 plotted against an estimate of environmental potential.

these data are very similar to those shown in Table 1, which were calculated from data obtained from trials carried out during the selection of N11.

The results show that in plant crops which had very favourable growing conditions N11 yielded slightly less cane per hectare than NCo 376. The sucrose content was, however, 1,8 units of pol higher for the N11 and this more than compensated for the smaller cane yield. This assessment of N11 agrees well with the plant cane performance of the variety in selection trials. The estimate of varietal stability based on the regression analysis, using yields from the NCo 376 standard plots, suggests that under the conditions studied there was little difference between N11 and NCo 376. The data suggest that N11 should compare favourably with NCo 376, irrespective of the yield potential of the area where it is grown.

Discussion

The limitations of this particular comparison are readily apparent. The yields of the two varieties were compared in plant cane only. The ratooning ability of a variety is probably of greater consequence in assessing varietal performance than yield in plant cane. The summer of 1977/78 was particularly favourable for cane growth and little stress was seen during the growth of the crop. A more meaningful evaluation will be obtained by extending the period of study into the ratoon crop. It will be necessary to ensure, however, that the control plots of NCo 376 are harvested at the same time that the new variety is cut for seed.

A second objection is that the variety is assessed at a relatively young age, and the yield at the stage of harvesting for seedcane may not be comparable with yield when the crop is ready for milling. This objection is probably more important in respect of sucrose content rather than of yield measured in terms of tons cane per month. However, during selection trials many determinations of sucrose content are made for both test varieties and NCo 376, and the relationship between them is well established.

The use of a single variety as a measure of the environmental potential is perhaps a more serious limitation of the method. However, a major objective in estimating yield in the seedcane plots was to obtain further information on the new variety in comparison with NCo 376. NCo 376 is also known to be an adaptable variety and erroneous comparisons due to the failure of the NCo 376 would be unlikely.

Conclusion

When a new variety is released for commercial cultivation there is a considerable amount of information available on its performance from selection trials. However, it would appear that additional worthwhile information may be quickly and easily obtained through systematic estimates of yields of the new variety and a comparable standard variety in the seedcane bulking phase. Since the plots concerned are unreplicated and are not necessarily planted under carefully controlled conditions, individual comparisons have to be treated with caution. Nevertheless, a useful comparison between a new variety and a standard variety may be obtained at this stage using the average yields derived from all suitable sites. Regression analysis techniques applied to the individual yield estimates of the new and standard varieties should give an indication of the adaptability of the new variety to a range of conditions.

The newly released variety N11 was evaluated by this method and the results obtained show broad agreement with the assessment of the variety made during selection trials. However, it is essential to extend the evaluation into the ratoon crop to obtain the maximum amount of information.

Acknowledgements

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