YIELD PERFORMANCE OF SOUTH AFRICAN SUGARCANE VARIETIES IN PLANT CANE TRIALS AT NCHALO SUGAR ESTATE, MALAWI

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Abstract

Within the framework of a requirement to increase productivity, a fluctuating world sugar price, a fixed area for cultivation and increasing financial constraints, the use of higher sucrose yielding varieties is one of the keys to more efficient and profitable sugar production. The use of superior varieties also reduces the risk of crop failure due to pests and diseases, unfavourable weather and soil conditions.

At Nchalo in Malawi, 85% of the cane grown is variety N14, which has succumbed to smut (*Ustilago scitaminea*) on the estate. New smut-tolerant and high sucrose South African (N) varieties from the South African Sugar Association Experiment (SASEX) Station's breeding program are being introduced to reduce the current dependence on N14 and to reduce the level of smut in this variety by improved disease management. Hence the performance of varieties, N19, N23, N25, N26, N28, N29, N30, N32 and unreleased SASEX varieties 82F2907 and 84F3078, were compared to N14 in three randomised block design trials, conducted in plant cane crops harvested early, mid and late season.

The results show that N14 had the highest cane and sugar yields in the early-season, 82F2907 in the mid-season and N25 in the late-season trials. This indicates that, in order to maximise sugar production for the season, the timing of harvest of different varieties should coincide with the period of their peak performance.

Keywords: sugarcane, varieties, productivity

Introduction

Nchalo varietal background
Nchalo estate is located in Malawi and comprises 12,270 hectares of irrigated sugarcane. The average annual rainfall is 690 mm and occurs primarily from December to March. Soils are alluvial and range from vertisols to sandy lenses. There is a high potential for salinity problems because of the high evaporation rates and flat terrain. Drainage, especially subsurface, is difficult. In the past NCo310 and subsequently NCo376 were the dominant varieties. They are both very susceptible to smut (*Ustilago scitaminea*) and have been completely phased out because of the high levels (>10%) of smut that occurred on the estate. N14, a relatively low smut susceptible variety, was introduced in the early 1980's and increased in area as the smut susceptible varieties were phased out. Until recently 85% of the cane grown was N14. N14 has also succumbed to very heavy smut infestation.

Smut rogueing and dipping setts in Bayleton (Triadimefon) before planting is being practiced for commercial fields. A two stage nursery system has been operating for a number of years, the first stage being a hot water treated (HWT) nursery.

The potential for flowering is high. Severe lodging can occur, especially during the rainy months, since the rain storms are usually short but intense with strong winds.

Nchalo is dependent on bagasse for fuel for its Factory boilers since it does not have access to alternative fossil fuels.

Varietal economics
The viability of a sugar estate is in part dependent on high yielding sugarcane varieties, to produce more sugar per unit area. It is of increasing economic importance to select the best varieties for specific environmental conditions and the best harvesting cycle (Redshaw and Nuss, 2001; Zhou, 1998). Zhou (1996) said that improved profitability can be realised when varieties are grown within their recommended harvesting periods.

Season
Cane yield is highly influenced by seasonal variations (Redshaw and Nuss, 2001; Zhou, 1998). Seasonal variations occurred for both cane and sucrose yields produced under irrigation in Zimbabwe and Swaziland. There was a marked decline in cane yield through the harvest season .The high cane yields from April to June were the result of optimum summer conditions coinciding with the period of rapid stalk elongation, whereas the lower yields obtained during late spring/early summer reflected the restriction on growth by low winter temperature (Sweet and Patel, 1985). The sucrose content of cane however generally peaked in July and August (Sweet and Patel, 1985).

Growth requirements
The important growth factors include good germination, rapid canopy formation, cane stalks of reasonable thickness, absence of flowering especially late season, erect growth habit or cane that does not lodge in high yield situations, ability to tolerate below average growing conditions and poor management. (Fauconnier, 1993).

Varietal importation
Varieties have been imported from SASEX to Malawi in the hope of finding a variety that meets the constraints highlighted above. Imports of new varieties from the SASEX breeding program are first tested in trails after preliminary screening at the Government plant quarantine facility.

Methodology

Three variety trials were established in commercial cane fields that were planted early (June 10 2000), mid (August 10 2000) and late (October 19 2000) season in heavy clay, sandy and heavy clay soils respectively. The varieties were planted at the time of the respective fields commercial crop.The trial cane was managed in the same manner as the respective field commercial crop.

The design was a randomised block design with 5 replicates of 12 varieties viz. N19, N23, N25, N26, N28, N29, N30, N32, 82F2907, 84F3078 and with N14 as the control. The nett plot size was 10m by 4 rows , with the rows spaced at 1.5m and surrounded by guard rows.

Smut observations were taken five times monthly, a month after planting, Flower scores were made a week before harvest to establish flowering percentage. Direct analysis of cane (DAC) samples of each plot, were taken a week before harvest to establish cane quality. Stalk counts of the middle 2 rows were made at harvest to establish plant population of millable stalks. Plots were burnt and weighed at harvest. The trials were harvested ,in July 7 2001, September 29 2001 and November 1 2001, for the early, mid and late season respectively.

Results

Analysis of variance was conducted on the data and is presented in Table 1.

Table 1. SASEX varietal performance compared to N14 harvested Early (T1), Mid (T2) and Late (T3) season at Nchalo, Malawi.

Variety	TERC/ha			TCH			ERC%			Fibre %			Millable stalk pop/ha			Flower %			% Smut whips		
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
N14	22.5	15.0	14.3	167.2	99.0	96.9	13.5	15.2	14.8	10.4	12.7	12.6	135740	94375	106228	26.8	24.5	50.1	0.36	0.40	0.63
N19	16.4	12.6	12.1	124.3	87.2	76.6	13.3	14.6	15.8	11.3	13.1	13.1	105339	94820	82115	5.5	0.0	0.5	0.64	0.33	0.63
N23	15.3	13.7	12.1	135.2	91.3	81.4	11.5	15.2	14.8	10.6	11.5	13.3	129606	106968	99783	19.1	30.5	71.5	0.00	0.37	0.00
N25	11.9	14.1	20.7	105.5	98.7	127.3	11.3	14.3	16.2	9.6	11.9	11.9	106805	88004	98005	2.3	2.3	4.6	0.00	0.00	0.00
N26	16.1	12.3	13.9	113.5	82.6	88.4	14.3	14.7	15.8	9.6	12.3	11.4	95205	81634	78115	19.0	16.2	44.1	0.28	0.13	0.00
N28	18.8	14.4	13.5	130.3	95.3	89.9	14.6	15.1	14.9	9.8	11.4	12.5	134407	116598	114895	4.5	10.6	21.6	0.52	0.40	0.10
N29	18.8	14.9	14.5	129.1	89.6	81.4	14.7	16.6	17.8	10.9	11.0	12.1	114006	96153	105116	21.4	12.2	33.8	0.12	0.03	0.00
N30	13.9	11.8	11.5	103.6	73.3	68.9	13.5	16.1	16.8	11.2	11.1	12.1	118139	87560	86115	2.8	3.8	44.5	0.00	0.00	0.00
N32	17.2	14.6	19.1	140.6	97.6	115.3	12.4	15.1	16.5	9.1	11.4	11.9	96138	95708	86004	3.0	3.8	0.6	0.04	0.40	0.00
82F2907	18.5	16.0	16.2	136.8	112.5	102.1	13.6	15.4	15.9	9.9	12.5	12.2	122939	113635	84560	14.0	11.8	0.8	0.32	0.33	0.03
84F3078	14.0	13.6	13.9	131.4	101.5	88.4	10.5	13.5	15.7	9.2	12.1	11.2	100272	88893	79893	14.6	8.7	46.5	0.36	0.73	0.47
CV %	12.2	13.0	7.9	11.4	12.5	7.6	7.8	4.3	2.6	7.7	6.1	3.7	10.1	9.3	6.0	31.1	46.8	14.7	93.4	96.2	125.7
SE	2.0	1.8	1.2	14.7	11.7	7.1	1.0	0.7	0.4	0.8	0.7	0.4	11511	8970	5561	3.8	5.3	4.3	0.22	0.27	0.21
LSD 5%	4.1	3.6	2.3	29.7	23.4	14.2	2.1	1.3	0.8	1.6	1.4	0.9	23253	18030	11177	7.6	10.6	8.6	0.45	0.55	0.43

Tonnes ERC/ha

All comparisons were made at the 5% LSD level.

Early season (T1): N14 had the highest TERC/ha and yielded significantly more than all varieties except N28, N29 and 82F2907. N25 recorded the lowest TERC/ha but was not significantly different from N23, N30 and 84F3078.

Mid season (T2): 82F2907 was the top ranking variety but was only significantly higher than N26 and N30. N30 had the lowest TERC/ha.

Late season (T3): N25 was the highest yielding variety and was significantly better than all varieties except N32. N30 as the lowest yielding variety but was not significantly different from N19, N23 and N28.

The unreleased variety 82F2907 yielded consistently well across all seasons and soil types. Both N14 and N29 did better than N32 in T1 and T2 although that difference was not always significant.

TCH

Early season (T1): N14 yielded significantly higher TCH than all varieties except N32. N30 was the lowest yielding.

Mid season (T2): 82F2907 was only significantly better than N19, N26 and N30. N30 was the lowest yielding.

Late season (T3): N25 was significantly better than all varieties except N32. N30 was the lowest yielding.

ERC%

Early season (T1): N29, N28, N26, were top ranking ERC% varieties early in the season and were significantly better than N23, N25, N26, N32 and 84F3078.

Mid season (T2): N29 had the highest ERC and was superior to all varieties except N30 and 82F2907.

Late season (T3): N29 was significantly higher than all varieties.

N29 was consistently ranked as having the highest ERC % throughout the year.

Other traits
N14 and N19 had high fibre content throughout. Other high fibre varieties were N14 and 82F (in two out of three seasons) and were not significantly different from N14 or N19.

High population varieties were N14, N23, N28, N29 and 82F2907.

Varieties that tended to flower more profusely were N14, N23 and N29.

Smut infection coefficient of variations were very high, mainly because the crop was a plant crop and hence levels of infection were very variable.

Varieties with low smut scores were N23, N25, N26, N29, N30 and N32. No smut was recorded in N25 and N32 in any of the trials.

Discussion

N14 was shown to be a variety with good sugar yields in the early to mid part of the season. While flowering was evident, the effects of flowering were not significant at this stage. Late season performance of this variety was poor. It is believed that this is partly due to the effect of flowering and extremely pithy nature of the stalk. Smut levels were already high in the plant crop of N14. N14 also has value as a high fibre variety, which is important for the Nchalo Factory.

Promising varieties were 82F2907, N25 and N32.

82F2907 still had smut but to a lesser extent than N14. The level of flowering was considerably lower than N14. The plant population was higher than most other varieties. It performed better than other varieties on the more sandy soils. It was a good all round variety.

N25 was more suited to mid to late season harvesting.. Smut susceptibility is very much lower than N14 and is not as prone to flowering. Unfortunately fibre levels are very low. A potential problem with N25 is the brittleness of this variety manifested by very easy stalk breakage at harvest and haulage. (Our experience of this variety commercially, indicates that this variety breaks into pieces very easily resulting in a lot of gleaning after harvesting as well as cane falling out of the haulage vehicles along the route to the factory.)

N32 also performed well in all seasons. The level of smut and flowering was much lower than for N14. Fibre levels were also low. The plant population of N32 was lower than 82F2907. It also tends to be more brittle than N14 manifested by the stalk breakage ease at harvest and during haulage.

Conclusion

In order to maximise sugar production for the season, the harvest of different varieties should coincide with the period of their peak performance. N14 was a good performing variety for early to mid season harvesting. Other potential varieties such as 82F2907, N25 and N32 need to be tested under a wider range of conditions and for more ratoons. So far these varieties also indicate reduced smut susceptibility. High sugar yielding varieties might have some attendant problems that reduce milling efficiency e.g. low fibre and brittleness resulting in increased gleaning costs and road spillage.

There are many facets to varietal selection which must be considered before commercial introduction since they have a bearing on crop husbandry, harvesting, and pest and disease pressure.

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