PERFORMANCE OF VARIETY MN1 IN MALAWI

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Abstract

Malawi receives pre-release varieties on an annual basis from SASRI for evaluation. Variety 82F2907, which was not released in South Africa, performed well in variety selection trials in Malawi and has been grown commercially from 1998. 82F2907 was given the commercial variety name of MN1. At the end of the 2004 season, MN1 occupied 4.4 and 10.4% of the Dwangwa and Nchalo cane areas respectively.

Results from the harvests of commercial fields indicate that, at Nchalo, MN1 has higher tons sucrose per hectare per annum (TSHA) than N14 and N25 when harvested in August and September. At Dwangwa, MN1 has higher TSHA than N25, N19 and NCo376 when harvested from August to November. The TSHA yields at both estates were similar to, or better than, the main varieties of cane cut up to July. MN1 generally has higher sucrose values than N25 and N14. The variety has similar fibre content to N14, and higher than N25, at Nchalo. Fibre content for MN1 is lower than NCo376 and N19 at Dwangwa.

At both estates cane yields improved from plant to first ratoon and then gradually decreased, despite a big variation between ratoons/years. MN1 yields better than N25 and N14 in sandy loam soils, and has a similar flowering intensity to N25, but less than N14, at Nchalo. Flower suppression trials at Dwangwa indicated that it responds to flower suppression by Ethephon. MN1 is less susceptible to smut than N14 and N25 in commercial fields at Nchalo. Commercial MN1 fields have tested positive for RSD, and YLS has been recorded in commercial fields, mostly at Nchalo.

Keywords: MN1, 82F2907, yield, flowering, disease

Introduction

There are two large sugar estates in Malawi, Nchalo Sugar Estate and Dwangwa Sugar Corporation. The soils and climatic conditions on the two estates differ quite markedly.

Nchalo estate, 12200 ha in extent, is located in the lower Shire river valley at 16º16'S, 34º53'E, 90 m above sea level. Nchalo receives an average annual rainfall of 658 mm, has an average maximum temperature of 32.1ºC and an average minimum temperature of 19.8ºC. Nchalo's average annual evaporation is 2035 mm and the average daily sunshine is 8.2 hours. The crushing season extends from April to November.

Dwangwa Sugar Estate, 6100 ha in extent, is located in the centre of Malawi along the shores of Lake Malawi at 12º30'S, 34º08'E, 480 m above sea level. Dwangwa receives an average annual rainfall of 1370 mm. Its average maximum and minimum temperature is 29ºC and

19.2ºC, respectively. The estate experiences an average annual evaporation of 2008 mm and 8.0 sunshine hours per day. Harvesting takes place from May to November.

Malawi has relied on other breeding centres, in particular the South African Sugarcane Research Institute (SASRI), for its source of varieties, and has imported varieties from SASRI by agreement for 28 years. These varieties, selected at the pre-release stage in South Africa, are tested on the two estates in replicated variety selection trials as well as commercially. Variety 82F2907, bred from N55/805 and N14 (personal communication[1]), has performed extremely well in Malawi. It was not released for commercial production in the South African sugar industry as it did not outperform N14, the control variety in the final stage variety selection trials conducted by SASRI (personal communication[2]). Malawi received pre-release variety 82F2907 in 1987 and, after going through quarantine for pest and disease observation, it was released for variety selection trials in 1993. Dwangwa estate started growing this variety commercially in 1997 and Nchalo estate in 1998. The area under 82F2907 gradually increased due to its good yield performance (Isyagi and Whitbread, 2002), and the variety has now been officially released and renamed MN1. It currently occupies 4.4% of the Dwangwa and 10.4% of the Nchalo cane areas.

The harvest season for the two estates is broadly defined as being early (April to mid July), mid (mid July to September) and late (October to December). All cane is cut annually, and averages 11.6 month of age at harvest.

The objective of this paper is to describe the performance of MN1 in variety selection trials and commercial fields in Malawi. MN1 is compared with varieties N14, N19, N25 and NCo376.

Materials and Methods

Variety selection trials

At Nchalo, trials 1225a and 1225b (early and mid season harvested trials, respectively) were run for three seasons. A late season harvested trial (Trial 1225c) ran for five seasons. These three trials were on sandy loam soils and were established in 1999. Trial 1225a had 10 treatments and 1225b and c had 11. They were replicated five times.

The variety has also been tried on clay and sandy soils. Trials 3709 and 7203, both on clay soil were cut early and late season respectively. They were established in 2000 and ran for four years. Trial 3709 had 12 treatments replicated five times and Trial 7203 had 11 treatments replicated five times. Trial 5182, established in 2000 on sandy soil, was cut late season and ran for two years. It had 12 treatments replicated five times. All Nchalo trials were randomised block designs (RBD). All trials included N14, N25 and MN1 and were harvested on a 12-month cutting cycle.

At Dwangwa two RBD trials, each with eight replications that contained MN1, N19 and N25 were carried out from 1997 and ran for five years. Trial 20 was cut mid season and Trial 21 was cut late season. Both these trials were on loamy soil and were harvested on a 12-month cutting cycle.

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Direct analysis of cane (DAC) for cane quality (pol%, fibre, purity, moisture and brix) was applied on all treatments. The treatments were weighed for estimated of tons cane per hectare (TCH) and tons sucrose per hectare (TSH). Flowering, lodging and susceptibility to smut were also assessed.

Commercial fields

Yield data for all fields on the two estates were obtained from the factory weighbridge. The fields were sampled for DAC. Tons cane per hectare per annum (TCHA), quality trait Pol%, and sucrose yield in tons sucrose per hectare per annum (TSHA) of all commercial MN1 for six years (1999-2004) were averaged and compared with those of commercial N14 and N25 at Nchalo and N19, N25 and NCo376 at Dwangwa. Variety performance on different soil classes was assessed at Nchalo only, and different harvesting cycles and ratoon performance were assessed at both estates and covered the full spectrum of early, mid and late harvest. The varieties were also assessed on their propensity to flower and their susceptibility to smut, ratoon stunting disease, and yellow leaf syndrome (YLS).

Results and Discussion

Variety selection trials

Detailed statistical results for all trials are given in Appendix 1.

Nchalo

In Trial 1225a harvested early in the season, MN1 had a pol% the same as N14, but lower than N25. TCH and TSH values were between those of N25 and N14 (Table 1). TSH means for the three varieties were not significantly different in any of the years under trial (Appendix 1).

In a mid season trial (1225b) MN1 and N25 had the same or similar pol%, TCH and TSH, which was higher than that of N14.

In the late season harvested Trial 1225c, MN1 had higher pol% than N14 and N25, but had lower cane yields. MN1 had the lowest TCH, and its TSH was between that of N25 and N14.

Table 1. Pol%, TCH and TSH for variety selection trials established in sandy loam soils and harvested early, mid and late season.

Variety	Trial 1225a (early)			Trial 1225b (mid)			Trial 1225c (late)		
	Pol%	TCH	TSH	Pol%	TCH	TSH	Pol%	TCH	TSH
MN1	16.4	131	21.3	16.1	157	25.2	16.5	128	13.2
N14	16.4	139	22.7	15.7	142	22.2	14.8	145	12.8
N25	16.9	115	19.2	16.1	156	25.0	16.1	133	14.3

In Trial 3709, a clay soil trial harvested early season, pol% for MN1 was higher than that of N14 and N25. TCH for N14 was higher than MN1. Consequently, N14 had the highest TSH, followed by MN1 (Table 2).

In the clay soil late season Trial 7203, Pol% for MN1 was lower than N25 and higher than N14. MN1 and N14 had the same TSH, which was lower than that of N25. Good performance of N14 and N25 was largely due to the clay soil type, which holds more water than a sandy soil.

MN1 in the sandy soil, late season Trial 5182 had slightly higher pol%, TCH and TSH values than N14 and N25 (Table 2). This is because of MN1's ability to withstand harsh conditions, i.e. the sandy soil.

Table 2. Pol%, TCH and TSH for variety selection trials established in heavy and light soils and harvested in early and late season at Nchalo.

Variety	Trial 3709 (clay) (early)			Trial 7203 (clay) (late)			Trial 5182 (sandy) (late)		
	Pol%	TCH	TSH	Pol%	TCH	TSH	Pol%	TCH	TSH
MN1	16.1	137	22.1	16.8	98.9	16.6	16.9	94.3	15.9
N14	15.2	157	23.8	16.0	104	16.6	16.5	90.3	14.9
N25	14.7	117	17.5	17.3	103	17.9	16.4	88.6	14.4

Dwangwa

In Trial 20, a mid season harvested trial, N25 had highest TCH, followed by MN1 (Table 3). Pol% for MN1 and N19 were similar and slightly higher than N25. TSH for MN1 and N25 were similar, both higher than N19. In late season harvested Trial 21, pol% for N19 was higher than MN1 and N25. N19 had a lower TCH than MN1 and N25. Consequently, TSH was similar for MN1 and N25, with both these varieties recording higher TSH than N19 (Table3).

Table 3. Pol%, TCH and TSH for a mid and late season harvested trial at Dwangwa.

Variety	Trial 20 (mid)			Trial 21 (late)		
	Pol%	TCH	TSH	Pol%	TCH	TSH
MN1	17.2	148.1	25.4	17.9	120.7	21.6
N19	17.1	138.6	23.7	18.2	102.5	18.6
N25	16.1	160.6	25.8	17.4	126.6	22.0

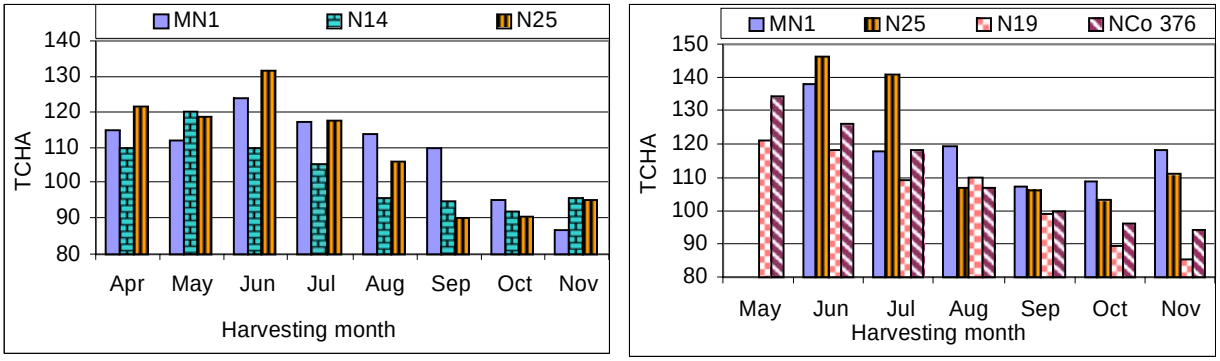
Commercial fields

TCHA by harvesting month

Monthly tons cane per hectare per annum data from 1999 to 2004 was averaged. Nchalo results (Figure 1a) indicate that MN1 TCHA was higher than N14 when harvested in April and again from June to October. MN1 TCHA was lower than N25 when harvested between April and June, higher than N25 from August and October, and again lower in November. At Dwangwa, MN1 yielded higher TCHA than N19 throughout the season (Figure 1b). MN1 was lower than N25 in June and July but higher from August to November. MN1 outperformed NCo376 throughout the season, except in July when they were similar.

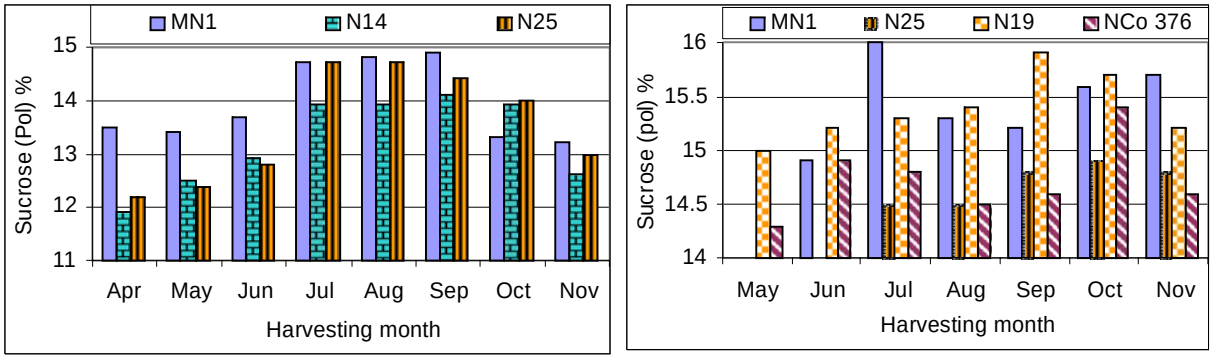
Pol% cane by harvesting month

At Nchalo, MN1 had higher pol% than N14 throughout the season, except for October (Figure 2a). MN1 had a higher pol% than N25 for all months except October, when it was less, and July when it was similar (Figure 2a). MN1 at Dwangwa had higher pol% than N25 and NCo376 from July to November (Figure 2b). Except for July and November, pol% for MN1 was lower than N19.



(a) Nchalo **(b) Dwangwa**

Figure 1. TCHA by harvesting month.

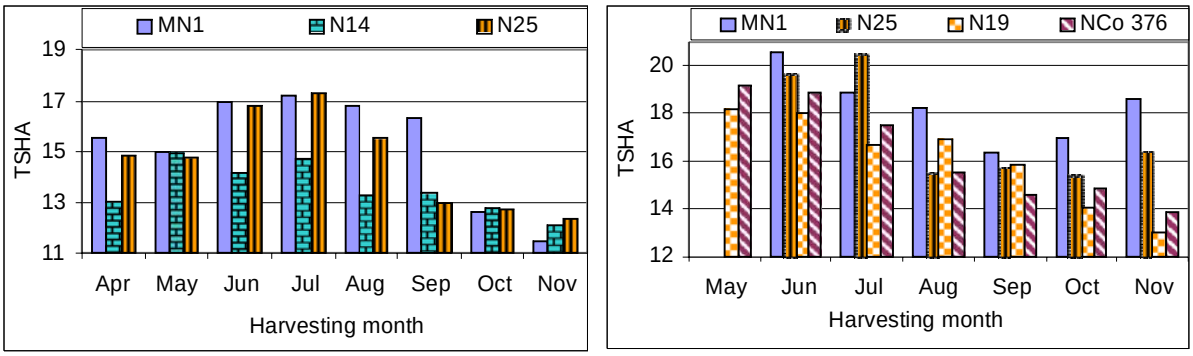


(a) Nchalo **(b) Dwangwa**

Figure 2. Pol% by harvesting month.

TSHA by harvesting month

At Nchalo, MN1 had similar, or higher, TSHA than N25 in all months except November. November's TSHA was low because of its low TCHA. MN1 performed similarly to, or better than, N14 from April to September and then fell below N14 in October and November (Figure 3a). At Dwangwa, MN1 had higher TSHA than N19 and NCo376 when harvested between June and November. It also had a higher TSHA than N25 from August to November (Figure 3b).

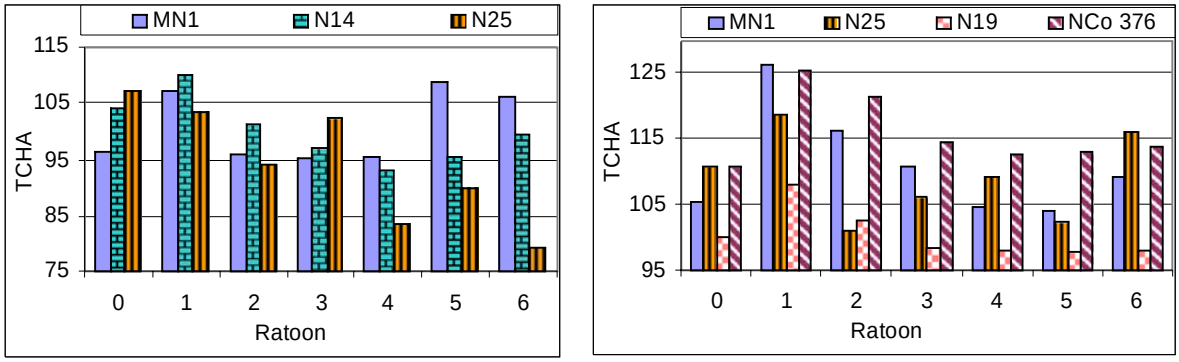


(a) Nchalo **(b) Dwangwa**

Figure 3. TSHA by harvesting month.

TCHA by ratoon

At Nchalo, MN1 yielded lower than N14 from plant to third ratoon (Figure 4a). Yields were higher than N14 and N25 from the fourth to the sixth ratoon. MN1 did not have the drop-off in yield that was seen in N25. At Dwangwa, except for first ratoon, MN1 yielded lower than NCo376. MN1 yields at each ratoon were higher than N19. Yield decline with ratoon age was similar to the other trial varieties (Figure 4b).

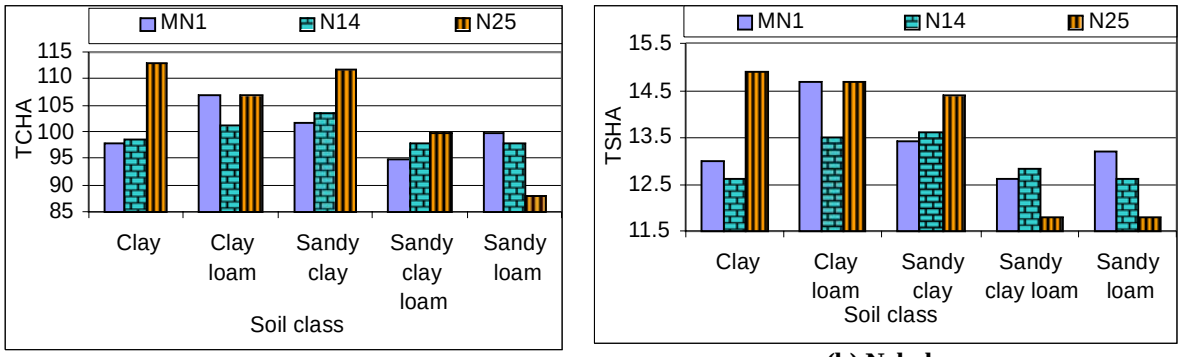


(a) Nchalo **(b) Dwangwa**

Figure 4. TCHA by ratoon.

TCHA and TSHA by soil class

Only data from Nchalo was available for determining yield performance in different soil classes. MN1 had higher TCHA and TSHA than N14 and N25 in sandy loam soils (Figures 5a and 5b). In sandy loam soils the highest TCHA was obtained in mid season, whereas the rest of the soil classes had the highest TCHA in early season.



(a) Nchalo **(b) Nchalo**

Figure 5. TCHA by soil class.

The average performance of MN1 against the main varieties at Nchalo and Dwangwa over the previous six years are summarised in Table 4. MN1 has proved to be a good sucrose variety with competitive cane yields and reasonable fibre content (Table 4).

Table 4. Summary of performance of MN1 and other major varieties from commercial fields over six years in Malawi.

Parameter	Nchalo			Dwangwa			
	MN1	N14	N25	MN1	N19	N25	NCo376
Pol%	14.3	13.5	13.9	15.5	15.5	14.8	14.7
Fibre%	14.1	14.0	13.5	14.9	15.2	14.7	15.2
TCHA	107.9	101.5	107.6	112.9	100.7	109.3	116.2
TSHA	15.4	13.7	15.0	17.5	15.6	16.2	14.1

Agronomic characteristics

Flowering

Flowering assessments were conducted in commercial cane at Nchalo estate from 1999 to 2004. MN1 flowered to the same extent as N25, but much less than N14 (Figure 6).

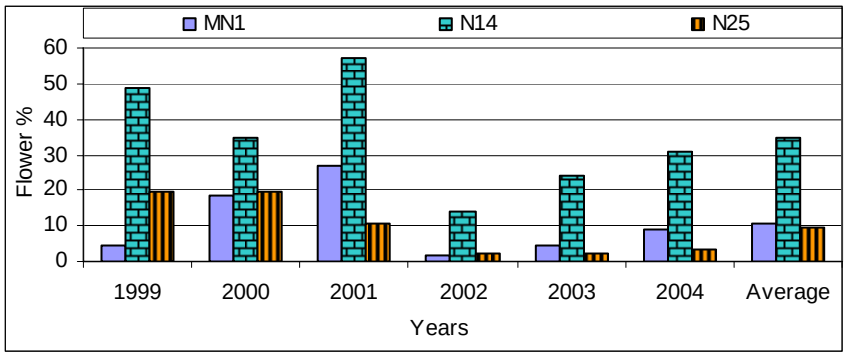
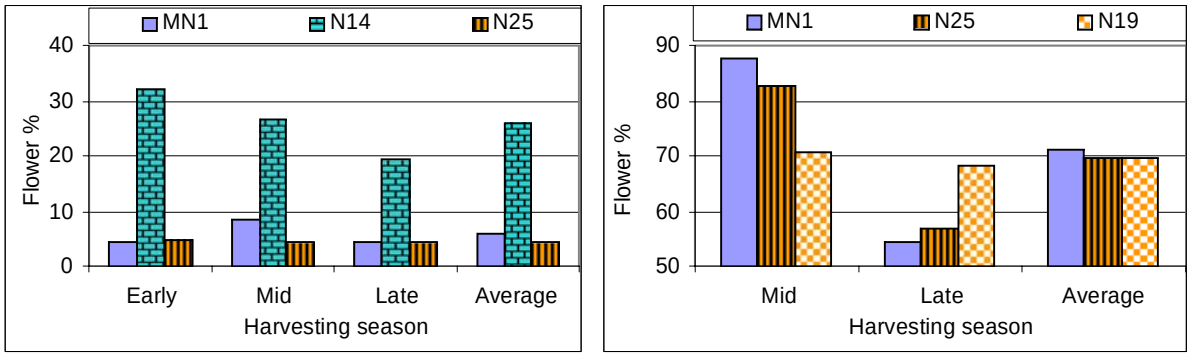


Figure 6. Average flowering percentage in commercial varieties at Nchalo.

Flowering was also assessed in the variety selection trials. These results show that MN1 had a similar flowering tendency to N25, but lower than that of N14 (Figure 7a).

At Dwangwa, where conditions are ideal for flowering, the percentage flowered stalks were much higher than at Nchalo. The amount of flowering in MN1 was similar to N25 in mid and late season (Figure 7b). MN1 flowered more profusely than N19 mid season, but not so in the late season. MN1 is therefore a variety that should be harvested late season.



(a) Early, mid and late season at Nchalo

(b) Mid and late season at Dwangwa

Figure 7. Average flowering % in variety selection trials.

Response to flower suppression by Ethephon

In large-scale observation trials carried out at Dwangwa, MN1 and other major varieties responded to flower suppression by Ethephon (Table 5). Results depict that 2004 was very conducive for flowering. This is evidenced by high flowering in cane that was not treated, and also in all varieties that were treated.

Table 5. Ethephon flower suppression results of commercial varieties at Dwangwa.

Year	MN1		N19		N25		NCo376	
	Treated	Not treated	Treated	Not treated	Treated	Not treated	Treated	Not treated
2003	10.2	15.5	4.2	17.8	2.7	25.4	29.6	75.5
2004	11	36.8	6.8	35.5	14	17.2	63.3	75.7
Mean	10.6	26.2	5.5	26.7	8.4	21.2	46.5	75.6

Diseases

Smut (*Ustilago scitaminenea*)

Smut is the most important disease at both Dwangwa and Nchalo estates. Fields are rouged at least three times in a season. Results in Figure 8 are for the first inspection, which was done in the fourth week for cane cut early season, and in the third week for mid and late season cut cane. In commercial fields, MN1 showed slightly less susceptibility to smut than N25, and considerably less than N14 at Nchalo. Smut levels in MN1 did not increase as much as those of N14 with increasing ratoons (Figure 8).

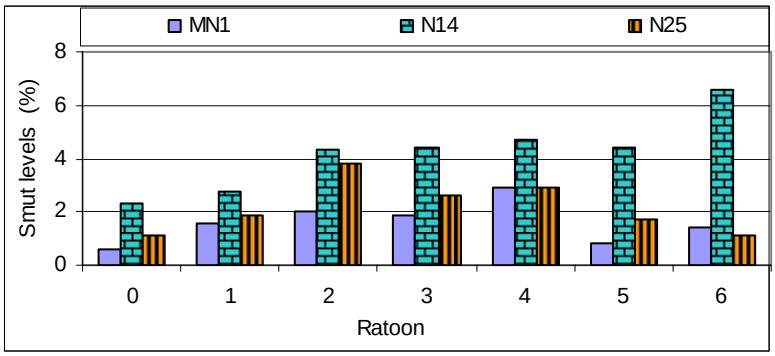


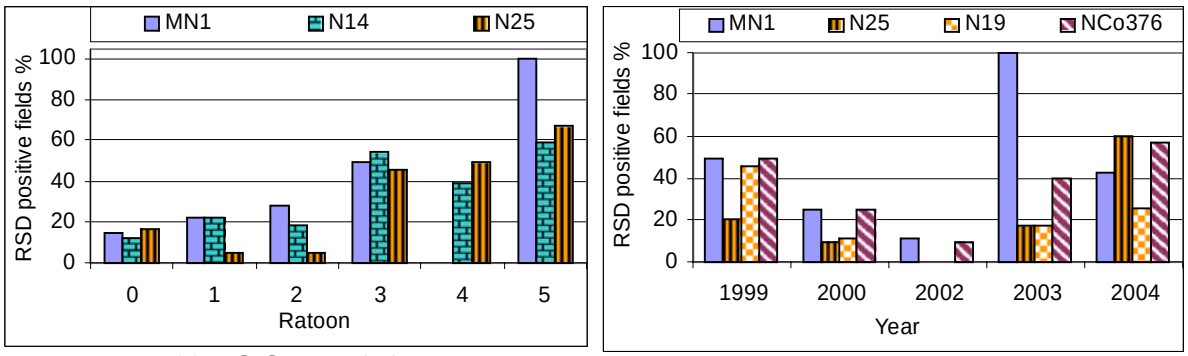
Figure 8. Percentage stalks with smut of three varieties commercially harvested at Nchalo.

In variety selection Trials 1225a, b and c at Nchalo, there were very little differences in smut levels between MN1, N14 and N25 (Table 6).

Table 6. Average percentage stalks with smut of varieties in MN1, N4 and N25 selection trials in plant cane and two ratoons at Nchalo.

Variety	Trial 1225a (early)	Trial 1225b (mid)	Trial 1225c (late)	Average
MN1	1.1	2.2	1.1	1.8
N14	1.6	2.8	1.8	2.1
N25	0.8	2.7	1.2	1.6

Ratoon Stunting Disease (RSD) (Leifsonia xyli *subsp* xyli*)*
When sampling for RSD, stunted stalks are targeted. Twenty stalks are sampled per field. Five sap samples, consisting of four stalks each, are dried and sent to SASRI for diagnosis. A third of each estate is sampled per year. The number of fields sampled is proportional to the variety disposition, i.e. more samples are taken from major varieties. The results from fields sampled on both estates (Figures 9a and b) showed that MN1 is highly susceptible to RSD. Nchalo results also indicated that the percentage RSD positive MN1 fields increased with ratoon age, as did N14 and N25. No RSD positive fields were identified in MN1 in the fourth ratoon at Nchalo.

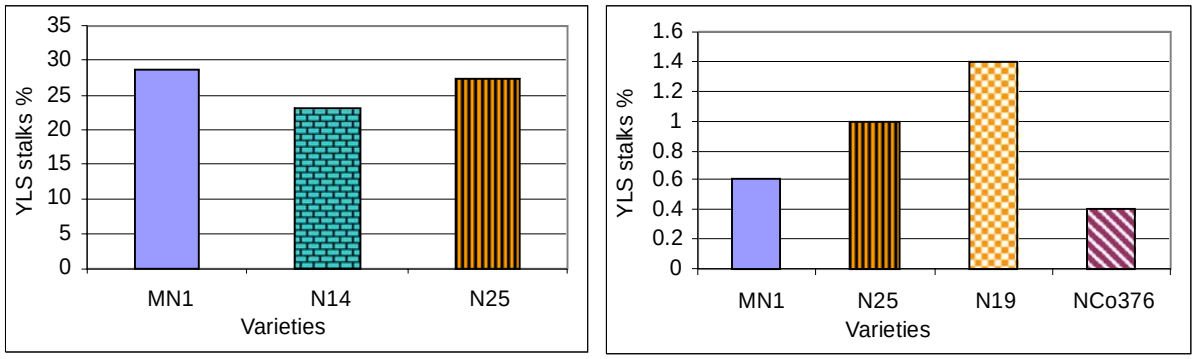


(a) Nchalo, 3 varieties **(b) Dwangwa, 4 varieties**

Figure 9. Percentage fields tested positive for RSD over six crops.

At Dwangwa, MN1 was more susceptible than N25 and N19, and almost similar to NCo376. During 2002, there were no N25 and N19 samples that were diagnosed positive for RSD.

Yellow Leaf Syndrome (YLS)
Visual assessment of varieties for YLS was done in 2003. At Nchalo YLS symptoms in MN1 were similar to N25, and slightly more than N14 (Figure 10a). At Dwangwa, MN1 showed fewer symptoms than N19 and N25 but more than NCo376 (Figure 10b). Rutherford (2003) found N19 to have a higher Sugarcane Yellow Leaf Virus (SCYLV) incidence than MN1 and N25 at Dwangwa.



(a) Nchalo **(b) Dwangwa**

Figure 10. Percentage stalks with YLS in commercial harvested fields.

Pokkah boeng
At Nchalo symptoms of pokkah boeng disease have been seen in MN1. From field observations, N25 seems more susceptible than MN1.

General observations

MN1 germinates more slowly than N14 and N25. However, germination is always very good, even after hot water treatment and delayed irrigation or planting. MN1 is better able to withstand lodging than N14 and N25. MN1 is less brittle than N25. It canopies similarly to N25, and faster than N14.

Conclusions

The variety selection programme has selected variety MN1, which is suited to the climatic and soil conditions of the two sugar estates in Malawi, for planting as a commercial variety. Generally, MN1 has a higher, or similar, pol% to the major commercial varieties of the two estates. The fibre content of MN1 is higher than N25. Cane yields early in the milling season are similar to the main commercial varieties grown, and MN1 outperforms N14, N19, N25 and NCo376 later in the season. MN1 has higher sucrose yields than the other main varieties from August onwards. Though MN1 also does better in early season, early season harvesting preference is given to other major varieties that flower profusely.

MN1 has been grown commercially up to sixth ratoon and its performance over ratoons has been better than N14, N19 and N25 but not as good as NCo376. At Nchalo, MN1 yields better than major varieties on sandy loam and clay loam soils. MN1 is a shy flowering variety at Nchalo but flowers similarly to other commercial varieties at Dwangwa. It responds to flower suppression when sprayed with ethephon. MN1 is less susceptible to smut, an important disease at the two estates, than N14 and N25. MN1 may be potentially more susceptible to RSD and YLS, but a more detailed investigation is required. MN1's performance mid and late season, together with its response to flower suppression, lends itself to being harvested late season.

Recommendations

- Nchalo estate should consider harvesting MN1 in August/September, or even later.
- Dwangwa must harvest MN1 from August to end of season. MN1 should be considered as a replacement for N19 and NCo376.
- Since MN1 has proved that it can do much better in harsh conditions (sandier soils) than the major varieties presently grown, Nchalo should plant its sandy fields to the variety.
- Although MN1 appears more susceptible to RSD, there is need to quantify the percentage stalks infected per field rather than the number of fields diagnosed positive, and this work has already started at Nchalo. The two estates also need to improve on sanitary crop husbandry practices in order to reduce RSD infection.
- With regards to mill fibre requirement, MN1 can better replace N14, which is dominant at Nchalo and has a similar fibre content.

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APPENDIX 1
Statistical variety trial results for Nchalo and Dwangwa

	Trial 1225a (Early) - Nchalo											
	POL%				TCH				TSH			
Year	2000	2001	2002	Mean	2000	2001	2002	Mean	2000	2001	2002	Mean
MN1	15.3	16.8	17.2	16.4	173	116	104	131	26.5	19.5	17.9	21.3
N14	15.9	17.0	16.3	16.4	168	135	113	139	26.7	22.9	18.4	22.7
N25	15.9	17.7	17.1	16.9	149	94.4	100	115	23.8	16.6	17.1	19.2
SE	0.48	0.61	0.34		9.82	16.6	6.27		1.75	2.73	0.99	
CV	2.98	3.53	2.04		6.91	16.5	6.58		7.73	15.8	6.2	
LSD5%	0.96	1.22	0.69		19.8	33.6	12.7		3.54	5.51	2.0	

	Trial 1225b (mid) - Nchalo											
	POL%				TCH				TSH			
Year	2000	2001	2002	Mean	2000	2001	2002	Mean	2000	2001	2002	Mean
MN1	15.3	16.4	16.7	16.1	159	129	182	157	24.2	21.2	30.2	25.2
N14	15.2	16.1	15.8	15.7	140	137	148	142	21.3	22.1	23.4	22.2
N25	15.3	16	16.8	16.1	181	121	166	156	27.6	19.4	27.9	25.0
SE	0.54	0.45	0.62		11.1	12.9	22.0		1.8	2.1	3.41	
CV	3.45	2.71	3.69		7.41	10.0	13.7		7.67	2.1	12.7	
LSD5%	1.1	0.91	1.25		22.4	26.1	44.5		3.63	10.4	6.88	

	Trial 1225c (late) - Nchalo																	
	POL%						TCH						TSH					
Year	2000	2001	2002	2003	2004	Mean	2000	2001	2002	2003	2004	Mean	2000	2001	2002	2003	2004	Mean
MN1	15.6	17.2	17.0	16.3	16.4	16.5	152	111	143	81.5	150	128	23.7	19.1	24.4	13.2	24.6	21.0
N14	14.7	15.1	15.1	15.3	13.6	14.8	196	114	176	83.8	154	145	29.2	17.2	26.5	12.8	21.0	21.3
N25	15.3	15.9	16.2	16.8	16.5	16.1	169	104	173	85.5	134	133	25.9	16.7	28.0	14.3	22.0	21.4
SE	0.57	0.55	0.57	0.6	0.6		17.9	14.0	15.2	9.7	19.5		3.19	2.4	2.5	1.5	3.1	
CV	3.65	3.34	3.45	3.62	1.62		10.7	13.3	10.5	12.9	15.9		12.2	13.8	10.7	11.9	15.6	
LSD5%	1.15	1.12	1.15	1.22	2.31		36.2	28.2	30.6	19.6	39.3		6.43	4.8	5.1	3.0	6.2	

	Trial 3709 (Clay – early) - Nchalo															
	POL%					TCH					TSH					
Year	2001	2002	2003	2004	Mean	2001	2002	2003	2004	Mean	2001	2002	2003	2004	Mean	
MN1	15.1	16.7	15.9	16.6	16.1	92.1	132	172	152	137	13.8	22.1	27.5	25.1	22.1	
N14	14.9	16.1	13.9	15.7	15.2	139	142	175	171	157	20.8	22.8	24.6	26.8	23.8	
N25	12.8	16.2	14.6	15.2	14.7	71	138	143	115	117	9.02	22.3	20.9	17.5	17.5	
SE	0.98	0.45	0.51	0.43		18.7	19.1	27	15.6		2.78	2.45	3.33	2.62		
CV	6.7	2.71	3.3	2.66		20.5	16.4	19.1	13.2		20.9	12.6	15.4	13.7		
LSD5%	1.98	0.91	1.03	0.87		37.7	38.6	54.6	31.6		5.61	4.94	6.73	5.3		

	Trial 5182 (Sandy – late) - Nchalo								
	POL%			TCH			TSH		
Year	2001	2002	Mean	2001	2002	Mean	2001	2002	Mean
MN1	16.9	16.9	16.9	116	72.2	94.3	19.6	12.2	15.9
N14	16.6	16.3	16.5	102	78.3	90.3	17.0	12.9	14.9
N25	15.6	17.1	16.4	102	75.1	88.6	16.0	12.8	14.4
SE	0.6	0.35		12.0	9.82		2.08	1.67	
CV	3.64	2.02		12.7	14.5		13.3	14.0	
LSD5%	1.22	0.72		24.3	19.8		4.2	3.36	

	Trial 7203 (Clay – late) - Nchalo														
	POL%					TCH					TSH				
Year	2001	2002	2003	2004	Mean	2001	2002	2003	2004	Mean	2001	2002	2003	2004	Mean
MN1	17.6	16.8	16.2	16.6	16.8	102	112	79.1	102	98.9	17.9	18.8	12.8	17.0	16.6
N14	16.3	15.4	16.3	16.0	16.0	96.9	118	81.8	119	104	15.8	18.2	13.4	19.0	16.6
N25	17.8	16.7	17.3	17.5	17.3	127	102	77.4	107	103	22.6	17.0	13.3	18.7	17.9
SE	0.36	0.44	0.33	0.36		7.28	8.92	6.12	11.0		1.29	1.54	1.05	1.82	
CV	2.05	2.55	1.94	2.08		7.85	8.57	8.54	11.7		7.97	8.61	8.57	11.2	
LSD5%	0.72	0.89	1.18	0.72		14.7	18.0	12.4	22.3		2.6	3.11	2.12	3.67	

	Variety Trial 20 (mid) - Dwangwa											
	TCH						POL%					
Year	1998	1999	2000	2001	2002	Mean	1998	1999	2000	2001	2002	Mean
MN1	193.34	150.05	138.80	117.38	141.08	148.13	16.66	16.51	17.58	17.59	17.48	17.16
N19	205.00	146.38	116.46	104.65	120.58	138.61	16.52	16.18	17.10	17.83	17.91	17.11
N25	193.76	171.04	156.05	130.99	151.21	160.61	15.26	15.36	16.36	16.49	16.89	16.07
CV	12.14	9.55	11.47	13.25	13.18		6.79	6.37	8.22	6.69	6.45	
LSD5%	22.88	14.81	15.22	15.32	18.10		1.11	1.06	1.42	1.18	1.14	

	Variety Trial 21 (late) - Dwangwa											
	TCH						POL%					
Year	1998	1999	2000	2001	2002	Mean	1998	1999	2000	2001	2002	Mean
MN1	133.75	106.42	138.34	100.69	124.28	120.70	16.90	18.93	18.06	17.57	18.10	17.91
N19	127.92	81.48	96.46	95.13	111.58	102.51	16.73	19.05	18.56	17.82	18.74	18.18
N25	151.25	104.94	141.05	107.17	128.53	126.59	16.48	17.65	17.07	17.24	18.39	17.37
CV	9.27	9.40	10.15	9.49	9.74		6.72	5.47	6.96	6.53	4.82	
LSD5%	12.22	9.49	11.79	8.89	11.24		1.11	1.01	1.26	1.14	0.88	