

VARIETY N21 – HAS ITS PLACE AND ITS PROBLEMS

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Abstract

Since the release of N21 to growers in the South Coast Region in 1990, the variety has been planted out commercially under a wide range of conditions with varying degrees of success. The diversity of conditions in which it has been planted and the erratic weather patterns since 1990 are factors that influenced its performance and led to grower confidence in the variety. This paper deals with an extension investigation aimed at putting growers in a position to make better informed decisions regarding the expansion of N21 on their farms by means of an assessment of the variety's performance in the 1995-96 season.

Introduction

One of the main functions of the Experiment Station is to release to the sugar industry varieties that have specific advantages over those previously released. In 1989, N21 was released as a variety reasonably resistant to the stalk borer *Eldana saccharina* Walker (Lepidoptera: Pyralidae), to smut, mosaic and rust diseases, and with a sucrose content slightly higher than NCo376.

Since its release, grower opinions of the performance of N21 have differed widely due to the influence of a number of factors. These factors include the droughts in 1992, 1993 and 1994; increasing *Eldana* levels; low labour productivity; other varieties suitable for the area; the age at which cane should be harvested; economics and improved rainfall since 1995.

The objective of this paper is to collate as much reliable information as possible about the variety, to give growers informed advice that will enable them to make decisions on the suitability of N21 in specific areas.

Method

Individual growers known to keep reliable and comprehensive records were approached on a coastal and inland basis to obtain information on cane, actual and relative sucrose yields and fibre levels. The division between coastal and inland cane was determined to be approximately 400 m altitude.

Information on variety N21 was gathered, as well as that for comparable fields of NCo376 and/or N12. A distinction was made between plant and ratoon cane. In addition to field yield records, varietal figures on individual stack weights and haulage vehicle payloads were obtained for comparison. Other information included row spacing, and general comments which included weed control, lodging, ratoonnability, ease of harvest and burning.

Eldana levels in N21 relative to comparable N12 or NCo376 surveys were obtained from the Umzimkulu and Sezela Local Pest and Disease Control Committees' team surveys. These results were separated into coast and inland farms for the calendar years of 1993, 1994 and 1995. Fields of similar cane age and time of survey were grouped and used in

the comparison. Cane quality data on N21, NCo376 and N12 for the 1995-96 season was obtained from the Umzimkulu mill, and N21 data from the Sezela mill.

The total area being grown to N21 as at 31 March 1995 on coastal and inland farms was noted, and total area as at 31 March 1996 was obtained from growers' first estimates. N21 is currently being grown in agronomy trials being conducted in the South Coast Region. Reference is made in this paper to cane and sucrose yields of N21, N12 and NCo376 included in these trials.

Results and discussion

Area planted to N21

As at 31 March 1995, an area of 531,4 ha had been planted to N21, with 406,5 ha situated on the coast and 124,9 ha inland. The area increased to 1 437,1 ha by the end of March 1996, with 914,9 ha on the coast and 522,2 ha inland. The increase in area occurred mainly under marginal soil conditions.

Timing of the release of N21 coincided with erratic rainfall seasons which constituted the droughts of 1992, 1993 and 1994, as shown in Table 1. *Eldana* levels increased dramatically during this period, which resulted in growers looking favourably on this variety because of its relative resistance to the pest. Due mainly to the threat of *Eldana*, as much as 250 ha of N21 has been planted on individual farms with poorer soils.

Table 1
Rainfall for the South Coast region for the period June 1989 to January 1996 compared with the long term mean (LTM)

Period	Rainfall (mm)		
	Actual	LTM	% LTM
June 1989 to May 1990	1 221,0	1 017,0	120
June 1990 to May 1991	839,0	1 013,0	83
June 1991 to May 1992	661,0	1 005,0	66
June 1992 to May 1993	550,0	994,0	55
June 1993 to May 1994	835,0	990,0	84
June 1994 to May 1995	1 079,0	991,4	109
June 1995 to January 1996	811,5	641,6	126

Coastal growers, at the same time, were becoming disillusioned with N12 because of its requirement for a longer growing period, and its proneness to flowering which prevented it from being carried over.

Cane and sucrose yields

For this paper, more commercial N21 cane results were expected. However, many fields had been used for seed and some growers' records were not sufficiently comprehensive. It was therefore not possible to reflect the variety's yield performance when harvested at different times during the year.

Results given in Table 2 have been separated for plant and ratoon cane on the coast, but inland plant and ratoon cane results are combined. Commercial cane yields in tons cane/ha/month indicated that N21 yielded more than N12 and NCo376 on both coastal and inland farms. When examining coastal sucrose yields, expressed as tons actual sucrose/ha/month, N21 produced more sucrose than both N12 and NCo376. However, inland NCo376 was superior to N12 and similar to N21.

Results from trials conducted at Equeefa and Seafield showed an advantage for N12 and NCo376 over N21 for tons cane/ha/month (Table 3). For tons actual sucrose/ha/month, harvested at two different times of the year, results showed no advantage for N12 and NCo376 over N21. The higher sucrose % cane level in N21 contributed to the differences between the three varieties.

The results, in tons sucrose/ha/month, contrast with a report by McIntyre *et al.* (1994) which found that N12 and

Table 2
Comparative yield and quality data of coastal and inland cane of varieties N21, N12 and NCo376

COASTAL							
Plant crop							
Variety	Area (ha)	Age (months)	Cane/ha (tons)	Cane/ha/mth (tons)	Actual sucrose per ha/mth (tons)	Relative sucrose per ha/mth (tons)	Fibre % cane
N21	38,1	14,56	75,40	5,17	0,60	0,62	16,10
N12	83,5	18,27	73,30	4,01	0,43	0,45	16,67
Ratoon							
N21	35,5	13,08	78,43	5,99	0,72	0,75	15,07
NCo376	173,6	12,75	67,18	5,27	0,68	0,64	15,03
Coastal summary							
N21	73,6	13,85	76,86	5,55	0,66	0,68	15,59
N12	83,5	18,27	73,30	4,01	0,43	0,45	16,68
NCo376	173,6	12,75	67,18	5,26	0,68	0,64	15,03
INLAND							
Plant and ratoon							
N21	20,3	17,38	99,95	5,70	0,68	0,54	15,43
N12	33,6	22,24	96,41	4,30	0,57	0,49	16,26
NCo376	25,6	21,60	112,81	5,20	0,68	0,70	15,65

Table 3
Cane and sucrose results from the Equeefa and Seafield trials harvested in 1995 (McIntyre, personal communication 1995)

Variety	Equeefa trial harvested 04.05.1995 at 17,1 months					Seafield trial harvested 19.09.1995 at 11,3 months				
	Cane (tons/ha)	Cane (tons/ha/mth)	SED	Actual sucrose (tons/ha/mth)	SED	Cane (tons/ha)	Cane (tons/ha/mth)	SED	Actual sucrose (tons/ha/mth)	SED
N21	106	6,2	8,5	0,7	1,2	73,1	6,5	7,2	1,0	1,2
N12	115	6,7	8,5	0,7	1,2	79,3	7,0	7,2	0,9	1,2
NCo376	108	6,3	8,5	0,6	1,2	81,3	7,2	7,2	1,0	1,2

NCo376 outperformed N21 in years of adequate to above average rainfall on both coastal and inland locations. It is difficult to find an explanation for these discrepancies and care must be taken with the interpretation of the 1995 results, as they relate to only one season.

General comment regarding N21 is that stalks elongate rapidly, and this feature has impressed growers. N21 is a variety that is difficult to estimate due to low stalk population, and stalk heights that exceed other varieties by more than 20%.

Fibre % cane

In Table 4, very little difference exists between the fibre % cane of the varieties delivered to the Umzimkulu mill and the N21 delivered to the Sezela mill. However, it is accepted that

Table 4
Fibre % cane for N21, N12 and NCo376 at Umzimkulu and Sezela mills for the 1995-96 season

Umzimkulu	
Variety	Fibre % cane
N21	16,0
N12	15,5
NCo376	16,0
Sezela	
N21	15,9

Table 5
Comparison of age (months) and *Eldana*/100 stalks for the calendar years 1993, 1994 and 1995 for coastal and inland cane

Year and site	N21			NCo376			N12		
	Area (ha)	Age (months)	e/100 stalks	Area (ha)	Age (months)	e/100 stalks	Area (ha)	Age (months)	e/100 stalks
1993									
Coastal	41,2	12,0	7,5	54,1	11,9	36,5	58,4	11,9	38,2
Inland	24,2	14,2	11,1	28,7	18,0	13,8	113,7	16,8	9,9
1994									
Coastal	36,5	10,8	4,2	78,6	11,1	17,8	94,4	11,5	12,9
Inland	17,4	11,4	11,2	3,2	12,0	17,0	18,1	12,3	16,4
1995									
Coastal	65,7	12,0	3,5	102,9	12,4	16,0	52,9	11,6	16,1
Inland	19,4	12,2	2,7	18,0	18,1	23,8	29,7	15,4	9,8

most of the N12 and about half the NCo376 cane refers to inland cane, whereas the N21 results for both Umzimkulu and Sezela refer mostly to coastal cane. The poor rainfall received in 1994 may also have influenced the fibre % cane levels, and in N12 in particular with its older age at harvest.

The fibre figures from Tables 2 and 4 have not shown the same trends as those published by McIntyre *et al.* (1994), in which N21 fibre levels were 2,2 units higher than NCo376, and from the Seafield trial results (¹personal communication, 1995) 3,6 units higher than NCo376.

Eldana

The results from Sezela and Umzimkulu Local Pest and Disease Control Committee surveys for *Eldana* in commercial cane support findings that N21 is relatively resistant to the pest (Table 5).

From Table 5, *Eldana* levels in terms of *Eldana*/100 stalks were consistently lower in N21 when compared with fields of N12 and NCo376 in the 1993, 1994 and 1995 calendar years. This is in keeping with the findings of McIntyre *et al.* (1994) and the SASA Experiment Station. The only exception occurred in 1993, when *Eldana* levels in N21 were higher than in N12 on inland farms. This was because of a large sample at Dumisa showing lower *Eldana* levels in N12 and higher levels being found in a smaller sample area from Oribi and Paddock.

Very low rainfall in 1993 and 1994 (see Table 1) resulted in considerable increases in *Eldana* levels on both coastal and inland farms. This trend made growers more interested in N21, particularly on inland farms where this resistant variety could be grown on a younger cycle due to its rapid growth characteristics.

On marginal coastal soils, N21 was found to outyield other varieties under droughted conditions and this, coupled with lower *Eldana* levels, increased the popularity of the variety. Coastal growers need a variety which is resistant to *Eldana* and can be carried over to extend cutting age. The proneness of N21 to lodging and the claim by growers that stalks become harder as the variety ages, unfortunately means that N21 may not be suitable to be carried over to 18 months. The maximum age recommended is 16 months.

Costing exercise

Agronomy trials conducted in the industry between 1991 and 1993 and reported by McIntyre *et al.* (1994) showed that, in a season of average rainfall (1991 crop), NCo376 outyielded N21 in tons sucrose/ha/annum by 0,5 units but, in a dry season (1993 crop), N21 outyielded NCo376 by 1,3 units of sucrose.

An 'average' season is defined as one in which the rainfall received by the crop varied around the long term mean by 20%, and a 'dry' season as one in which the rainfall received by the crop was 70% or less than the long term mean. The 1991-92 and 1995-96 seasons are therefore considered average years, whereas the 1993-94 season is considered a dry year.

In the 1995-96 season, the average stack weight for N21 was 3,5 tons/man-day and for NCo376, 4,6 tons/man-day. These average stack weights were achieved in burnt cane, cut and stacked. These data were obtained from cutter performance in 58,7 ha of N21 and 263,9 ha of NCo376.

The average haulage vehicle payload for burnt N21 in 1995-96 was 25,2 tons and for burnt NCo376, 29,1 tons. These figures were calculated using delivery information from 85,2 ha of N21 and 310,9 ha of NCo376.

A costing exercise was undertaken for a hypothetical farm to determine the financial implications of growing different proportions of N21 in an average and a dry season, because it was considered that financial losses might be incurred from harvesting and transporting N21 with its poor stack weights and hilo payloads. The influence that stack weights and hilo payloads of N21 had on the overall costs of harvesting and haulage in an average and a dry season were calculated.

The influence of marginal revenue from planting different proportions of N21 in an average and a dry season on net farm income was also calculated. By illustrating the net effect on farm revenue in an average and a dry season, growers can make informed decisions on whether it would be worthwhile planting N21 by relating these figures to the frequency of drought and the soil potential of their farms.

The exercise required that average stack weights and hilo payloads of N21 and NCo376 for a dry season be determined. Because of the very small sample size of N21 in the drought years, it was necessary to make assumptions in consultation with growers who have experience with N21.

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The following assumptions were made:

Farm size:	134 ha
Area harvested:	107 ha (80%)
Average age at harvest:	15 months
N21 stack weight (dry year):	3,0 tons/man-day
NCo376 stack weight (dry year):	3,2 tons/man-day
N21 hilo payload (dry year):	20 tons
NCo376 hilo payload (dry year):	20 tons
1998-99 average sucrose price:	R933,00/ton sucrose
Haulage cost at 20 km from mill:	R12,30/ton
Haulage cost at 40 km from mill:	R17,80/ton
Contract rate (average season):	28 tons/hilo
Haulier penalty rates (average season):	34c/ton underweight at 20 km
Haulier penalty rates (average season):	75c/ton underweight at 40 km
Cutter wages (average season):	R5,20/ton
Cutter wages (dry season):	R5,70/ton
Basic task (average and dry season):	3 tons/man-day
Cutter bonus (average and dry season):	R2,00/ton

The exercise determined harvesting and haulage costs at 20 and 40 km from a mill where N21 made up 10, 20 and 40% of the farm (balance of farm NCo376) in an average and dry season. Marginal revenues were calculated for the same proportions of N21 and NCo376 in an average and poor season using an estimated sucrose price of R933,00/ton (1998-99 season average sucrose price).

It was assumed that commercial hauliers would not change haulage rates in a dry season nor impose penalties. In the absence of a significant sample size, hilo payloads were fixed at 20 tons for both NCo376 and N21 to eliminate any bias in favour of N21 in a dry season.

Industrial agronomy trial results from 1991 (average season) and 1993 (dry season) were averaged and extrapolated to a harvesting age of 15 months for use in the exercise. It was decided not to use commercial field results from the 1995-96 season as trial results were considered more meaningful.

From Table 6, the harvesting and haulage costs in an average season increase as the percentage area grown to N21 increases.

From Table 7, the harvesting and haulage costs for the hypothetical farm decrease as the proportion of N21 increases. This is because the total farm production decreases in an average year as more N21 is grown.

Table 6

Harvesting and haulage costs for different proportions of N21 grown during an average season on a 134 ha farm, at 20 and 40 km from the mill, compared with 100% NCo376

Proportion and variety	Harvesting cost (R/ton)	Infield haulage (R/ton)	Transloading (R/ton)	Road haulage (R/ton)	Total cost (R/ton)
100% NCo376	5,90	4,83	2,45	14,44	27,62
10% N21	5,86	4,92	2,49	14,67	27,94
20% N21	5,82	5,01	2,51	14,89	28,23
40% N21	5,74	5,19	2,57	15,37	28,87

Table 7

Summary of harvesting and haulage costs for different proportions of N21 grown during an average season on a 134 ha farm, at 20 and 40 km from the mill, compared with 100% NCo376

Proportion and variety	Harvesting & haulage costs (R/farm)	
	20 km	40 km
100% NCo376	262 045	319 718
10% N21	-(1 776)	-(2 304)
20% N21	-(3 382)	-(4 443)
40% N21	-(4 470)	-(5 072)

From Table 8, the harvesting and haulage costs decrease as the proportion of N21 increases. This is because the total farm production increases relative to 100% NCo376 in a dry year. The difference between costs reflected in Tables 6 and 8 are as a result of the farm producing a lower tonnage in a dry year.

From Table 9, the harvesting and haulage costs for the hypothetical farm increase as the proportion of N21 increases. This is because the total farm production increases as more N21 is grown.

Table 9

Summary of harvesting and haulage costs for different proportions of N21 grown during a dry season on a 134 ha farm, at 20 and 40 km from the mill, compared with 100% NCo376

Proportion and variety	Harvesting and haulage costs (R/farm)	
	20 km	40 km
100% NCo376	178 963	211 330
10% N21	+ 1 470	+ 1 823
20% N21	+ 2 990	+ 3 695
40% N21	+ 6 096	+ 7 510

Table 10 shows that farm gross revenue, relative to 100% NCo376, decreases in an average season as the percentage

Table 8

Harvesting and haulage costs for different proportions of N21 grown during a dry season on a 134 ha farm, at 20 and 40 km from the mill, using an interlink haulage vehicle, compared with 100% NCo376

Proportion and variety	Harvesting cost (R/ton)	Infield haulage (R/ton)	Transloading (R/ton)	Road haulage (R/ton)		Total cost (R/ton)	
				20 km	40 km	20 km	40 km
100% NCo376	5,83	8,52	3,76	12,30	17,80	30,41	35,91
10% N21	5,82	8,48	3,73	12,30	17,80	30,33	35,83
20% N21	5,80	8,44	3,72	12,30	17,80	30,26	35,76
40% N21	5,77	8,38	3,68	12,30	17,80	30,13	35,63

area grown to N21 increases. This is due to the inferior performance of N21 in an average season relative to NCo376. In a dry season, farm gross revenue, relative to 100% NCo376, increases as the percentage area grown to N21 increases. This is due to the superior performance of N21 relative to NCo376 in a dry season.

The differences in yields between N21 and NCo376 in tons sucrose/ha/annum are less in an average season relative to a dry season. This accounts for gross farm revenue decreasing and increasing at different rates.

Table 10

Marginal revenue from growing different proportions of N21 in an average and a dry season on a 134 ha farm, compared with 100% NCo376

Proportion and variety	Farm gross revenue	
	Average season (R)	Dry season (R)
100% NCo376	1 247 888	628 935
10% N21	- (5 989)	+15 974
20% N21	-(11 979)	+31 946
40% N21	-(23 959)	+63 892

Table 11 illustrates the net revenue differences from growing different proportions of N21 relative to 100% NCo376, at 20 and 40 km from the mill, in an average and a dry season. Increasing financial losses are incurred as the proportion of the farm grown to N21 increases in an average season. Where the farm is comprised of 40% N21 and 60% NCo376 and is situated 40 km from the mill, farm revenue would be reduced by R18 887, for example. Increasing financial gains are to be had as the proportion of N21 grown on the farm increases in a dry season. Where the farm is comprised of 40% N21 and 60% NCo376, and is situated 40 km from the mill, farm revenue would increase by R56 382, for example.

Table 11

Net revenue difference from growing different proportions of N21 in an average and a dry season on a 134 ha farm, at 20 and 40 km from the mill

Proportion and variety	Net revenue differences (R)			
	Average season		Dry season	
	20 km	40 km	20 km	40 km
100% NCo376	985 843	928 170	449 972	417 605
10% N21	-(4 213)	-(3 685)	+14 504	+14 151
20% N21	-(8 597)	-(7 536)	+28 956	+28 251
40% N21	-(19 489)	-(18 887)	+57 796	+56 382

Other costs, eg levies, change with different seasons, but these were considered insignificant and hence ignored in this exercise. It was also assumed that fertiliser and weed control costs would remain unchanged due to the same area being cut each season and as such would not influence the findings.

The decision on whether or not N21 should be planted, and to what extent, depends on how often the crop comes under stress. Should a particular farm be comprised of lower potential soils, be situated in a rain shadow area and as a result be subject to extended periods of moisture stress and high

Eldana levels, it might well be financially advantageous to plant N21. The opposite is true for a farm comprised of higher potential soils and situated in a high rainfall area.

General comments

Increase plant populations at the time of germination

Although N21 germinates well, in order to ensure a good stalk population at germination, double stick planting is practised. This appears to ensure increased germination and quicker canopy in the plant crop. It is doubtful whether this advantage is passed on to the ratoons.

Weed control and row spacing

Due to the erectness of the leaves and a lower stalk population (18% less than NCo376) (McIntyre *et al.*, 1994), N21 has an open canopy. As a weed problem was envisaged, growers initially planted N21 at a row spacing of 900 mm. However, those who have planted at row spacings of 1,0 or 1,2 m have not experienced weed problems. This is due to the generally good weed control techniques of the growers and the efficacy of herbicides, and this is particularly true of the 1995-96 season.

Creeping grasses such as *Cynodon dactylon* are the greatest threat to N21. The use of herbicides, especially Glyphosate, under the canopy to control creeping grasses once stalk height has reached 1 m, is made difficult by continued tillering throughout the crop's life. To avoid weed competition in N21, with its low plant populations, it is preferable to use long term herbicides. Growers have not found additional herbicide applications in N21 necessary, over those normally applied to other varieties. Growers comment that the last weeding in N21 takes place as close to the canopy stage as with other varieties and an extra hand weeding is not normally required.

Growers' preference for row spacing is 1,0-1,2 m. This is either due to a reluctance to change row spacing or because of tractor wheel damage to cane lines with narrower spacings.

Poor ratooning

Grower experiences are that fields of N21 harvested from May to July have generally not ratooned as vigorously as those cut from August to December, due to cold soil temperatures and possibly less moisture in the soil. This is particularly true of the variety growing on poor shallow soils, especially Dwyka Tillite derived soils and south facing slopes. These observations cannot be substantiated by trial data due to inconsistent findings.

In order to avoid harvesting during May to July, N21 should be planted early in spring. This allows the plant crop to be cut in summer at 14-15 months of age. March planting may enable harvesting in August at 17 months, although, depending on the season, the cane may already have lodged severely.

Strip harvesting

N21 has relatively little trash and this trait, coupled with its tendency to self-trash, makes it safe to burn. This makes the variety suitable for a strip planting/harvesting programme. The self-trashing characteristics also enables the variety to be trashed easily.

Hard rind

N21 has a relatively hard rind which is unattractive to monkeys, and many growers have planted the variety adjacent to

areas of natural bush. Although there is no evidence from trial observation, the comment from cutters is that the older N21 becomes, the harder it is to cut. This affects cutter productivity and may be a serious threat to labour employment.

Flowering

N21 does not flower readily, which is in keeping with research findings. This attribute, coupled with its resistance to *Eldana*, makes it a variety which can be carried over on the coast. However, its tendency to lodge and ratoon poorly when cut from May to July, may decide its fate as a carry-over variety.

Performance of N21 in different soils

N21 has grown well on a range of soil types which include Table Mountain Sandstone (TMS), Dwyka tillite, Granite and Recent Sands. On good deep soils, growth is excellent and stalk extension very impressive. However, it is on the poorer soils which stress, including hill tops, that its growth is better than that of other varieties. These soils would include those that are derived from Dwyka tillite and Granite parent materials. On soils derived from TMS and Recent Sands, growth has been poor where clay contents are low, ie below 6%. It has grown satisfactorily on Hutton form soils where the clay % is greater than 12%. No experience has been gained on heavy black soils or from soils prone to waterlogging.

Conclusion

Commercial field data from the 1995-96 season confirm that N21 performed as well as NCo376 and N12, in a season of favourable growing conditions, although trial results as reported by McIntyre *et al.* (1994) were to the contrary. McIntyre *et al.* (1994) showed that, during the drought years of 1992, 1993 and 1994, N21 outyielded NCo376 and N12 in all trials conducted over that period, and grower observations during the above drought years support these findings.

The rainfed areas of the South Coast region, with its diversity of soil types, the majority of which can be considered

poor, will always experience extended periods of moisture stress and fluctuating *Eldana* levels. This means that, until a superior variety with the same *Eldana* resistance as N21 is bred, there will be a place for N21 on most farms.

While N21 may be financially advantageous in a dry season, it is also important to consider the influence on labour attitudes of having up to 40% of a farm comprised of a variety which is difficult to cut. The difficulty cutters have in harvesting N21 is, in the opinion of growers, one of the variety's most important disadvantages. This is particularly true of N21 older than 16 months. These are some of the practicalities which can often override a straight forward economic assessment.

On coastal Dwyka tillite derived and similar problem soils, *Eldana* levels have a significant effect on cane yield, and the differences between cane and sucrose yields of N21 on these soils in comparison with other varieties are greater. On these soils greater proportions of N21 would be justified, provided it is not allowed to age and lodge heavily.

The above comment also holds for poor soils on inland farms. If inland growers are forced to cut cane at a young age due to *Eldana*, N21 might become an important variety at high altitudes. The proportion of the farm planted to N21 would depend on the extent to which the farm is comprised of poor soils.

Finally, the authors conclude that, although N21 performed satisfactorily in the 1995-96 season, they would still consider it a variety for limited conditions considering trial findings and other disadvantages. It is a site-specific variety that requires careful management to realise its potential.

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