MANAGEMENT OF PRIME QUALITY HIGH PROTEIN WHEAT IN SOUTH AUSTRALIA

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Abstract

Research is being conducted to determine whether it is possible to develop management packages, suited to South Australia, to consistently produce grain which meets the stringent protein and flour characteristics required by the end users of Prime quality, high protein wheat. Results of trials conducted in the low rainfall areas of the northern Murray Mallee and upper Eyre Peninsula indicate that well adapted varieties are available that are capable of producing high protein grain with flour characteristics equivalent to those expected of Prime Hard. The major agronomic problems associated with the production of such grain in these areas are low yield and short grain filling periods.

Key words: Wheat, protein, rotation, N rates, prime quality.

It has been known for over 60 years that parts of the upper Eyre peninsula and northern Murray Mallee consistently produce high protein wheat (1). In many years the protein levels of the grain exceed 13%, which is the required minimum standard to achieve the Prime Hard classification of northern NSW and Queensland.? At the present time, Prime Hard wheat is produced from a restricted area where only recognised varieties are received. These varieties are capable of producing wheat of the required minimum protein and also produce flour which meets the needs of the end user. If the area suited to the production of Prime Hard is expanded to include parts of the southern wheatbelt this should result in increased production of this grade with a consequent increase in grower payments. In addition, the increase in production zones is likely to reduce the impact of local droughts and so decrease the probability of marketing authorities being unable to meet their long term contractual obligations.

The objective of this research is to determine whether it is possible to develop management packages, suited to South Australia, to consistently produce grain which meets the stringent protein and flour characteristics required by the end users of Prime quality, high protein wheat.

Methods

Replicated split split plot factorial management trials were sown at the density of 200 germinable wheat seeds/m2 at Minnipa (sown 8/7), Roseworthy (sown 21/6) and Wunkar (sown 22/5) in 1996. In 1997 similar trials were sown at Cungena (sown 17/6) in addition to the sites at Minnipa (sown 13/6), Roseworthy (sown 22/5) and Wunkar (sown 5/6).

For 1996, there were 4 replications of 3 pre-treatments (green manure, oats and mechanical/chemical fallow), 4 varieties (Janz, RAC 820, Molineux and Suneca) and 6 nitrogen treatments (0, 15 kg N, 30 kg N, 45 kg N, 15 at sowing + 15 kg N at tillering (Zadok 23) and 15 at sowing + 15 kg N at anthesis (Zadok 65).

In the 1997 trials the Prime Hard variety Sunstar was used instead of Suneca. The Minnipa and Roseworthy sites included a field pea pre-treatment instead of vetch whilst the Cungena trial was sown to wheat after three cereal pre-treatments (triticale and two wheat varieties).? All other treatments were those used in 1996.

High protein grain samples from these trials were sent to Wagga Wagga for flour and dough testing. Grain yield, dry matter production, soil nitrate and soil moisture content data were collected at each site.

Table 1: Mean yield t/ha at Minnipa and Wunkar in 1996

pre-treat.	vetch	oats	chem/fallow				l.s.d.(0.05)
Minnipa	0.876	0.911	1.018				0.111
pre-treat.	medic	mech/fallow	chem/fallow				
Wunkar	0.723	0.870	0.823				0.040
variety	Molineux	Suneca	Janz	RAC820			
Minnipa	0.778	0.831	1.059	1.072			0.045
Wunkar	0.459	0.824	1.062	0.876			0.053
N treat.	zero	15 kgN	30 kgN	45 kgN	15,15t	15,15a	
Minnipa	0.895	0.956	0.949	0.960	0.921	0.929*	0.031
Wunkar	0.780	0.807	0.812	0.800	0.831	0.802	n.s.

* Note: The 15 kg addition at anthesis was not made because of the sudden finish to the season. 15a=15 kgN at anthesis, 15t=15 kgN at tillering.

Results and discussion

1996 grain yields

Severe waterlogging at the Roseworthy site resulted in the loss of useful data. At Wunkar and Minnipa the trial was sown late due to the late break and so average yields were low, 0.805 and 0.935 t/ha, respectively.? There was no significant yield response to either rate or? time of nitrogen application at Wunkar while at Minnipa, significantly higher yields were obtained with the addition of 15, 30 or 45 kg/ha of N at sowing. At Wunkar, significantly higher yields were obtained on plots following a mechanical fallow whereas at Minnipa, the highest yields were obtained following chemical fallow. Janz gave significantly higher yields at Wunkar, but RAC820 and Janz produced the highest yields at Minnipa. Molineux yielded least at both sites.? There was no significant interaction at Minnipa, where-as at Wunkar a significant pre-treatment by variety interaction was apparent. Mean yields for all treaments at each of the sites in 1996 are shown in Table 1.

1997 grain yields

At Cungena mean yield was low (0.689 t/ha) due to very low and poorly distributed rainfall. Yields at the other three sites were close to average even though it was very dry in June, July and October (Roseworthy 2.127 t/ha, Minnipa 1.464 t/ha and Wunkar 1.256 t/ha).

At Cungena, the highest yields were obtained from the zero N treatments, and RAC820 was the highest yielding variety. There was no significant difference between the pre-treatments at this site.All interactions were not significant.

At Minnipa, there was a significant pre-treatment effect with the chemical fallow yielding most. Molin-eux and Janz yielded significantly more than the other two varieties. The pre-treatment by variety interaction was significant. There was no significant effect of either rate or time of application of N at this site.

At Roseworthy and Wunkar, the 0 N treatment was inferior to all other N treatments which did not differ significantly from one another. There was no significant pre-treatment effect at either site. At Roseworthy, Janz had a significantly higher yield than all other varieties with Molineux having a significantly lower yield. The pre-treatment by N treatment interaction at Roseworthy was significant. At Wunkar, Molineux had a significantly lower yield than the other three varieties which did not differ significantly from one another. No significant interactions were present. Mean yields for all treatments at each of the sites in 1997 are shown in Table 2.

1996 protein percentages

All protein analyses were derived from samples bulked across replicates and so it is not possible to calculate l.s.d.'s. At Minnipa, the highest average grain protein percentages were obtained with the addition of 15 kg/ha of N at sowing + 15 kg/ha at tillering, following chemical fallow and from the variety Molineux.

At Wunkar the highest average grain protein percentages were obtained with the addition of 45 kg/ha of N at sowing, following mechanical fallow and from the varieties Molineux and RAC820 (Table 3). As can be seen from Table 3, all protein percentages were well above the minimum requirement of 13% at both sites. Data is not yet available for 1997.

1996 1000 grain weight

Grain filling was restricted at both sites, as a result of the dry conditions in late September and October. Consequently, 1000 grain weight measurements (Table 4) were below those usually accepted into the Prime hard pool in northern NSW. Dry conditions at the end of the growing season are characteristic of the two sites and early seeding may be critical in achieving acceptable grain size. All 1000 grain weight measurements were derived from samples bulked across replicates and so it is not possible to calculate l.s.d.'s. Data is not yet available for 1997.

Table 2: Mean yield (t/ha) at Cungena, Minnipa, Roseworthy and Wunkar in 1997

pre-treat.	Tahara	Frame	BT Schomburgk				l.s.d.(0.05)
Cungena	0.578	0.717	0.771				n.s.
pre-treat.	peas	oats	chem/fallow				
Minnipa	1.460	1.176	1.755				0.399
pre-treat.	peas	oats	chem/fallow				
Roseworthy	2.355	2.143	1.884				n.s.
pre-treat.	medic	mech/fallow	chem/fallow				
Wunkar	1.258	1.295	1.216				n.s.
variety	Molineux	Sunstar	Janz	RAC820			
Cungena	0.658	0.623	0.665	0.810			0.108
Minnipa	1.523	1.403	1.529	1.401			0.074
Roseworthy	1.871	2.195	2.354	2.088			0.112
Wunkar	1.018	1.360	1.325	1.322			0.055
N treat.	zero	15 kgN	30 kgN	45 kgN	15,15t	15,15a	
Cungena	0.734	0.683	0.670	0.664	0.707	0.676*	0.032
Minnipa	1.438	1.475	1.469	1.464	1.458	1.480*	n.s.
Roseworthy	1.946	2.170	2.204	2.162	2.130	2.152	0.114
Wunkar	1.194	1.270	1.283	1.279	1.263	1.250	0.048

* Note: The 15 kg addition at anthesis was not made because of the sudden finish to the season. 15a=15 kgN at anthesis, 15t=15 kgN at tillering.

Table 3: Mean protein % at Minnipa and Wunkar in 1996

pre-treat	vetch	oats	chem/fallow			
Minnipa	14.0	14.3	15.2			
pre-treat	medic	mech/fallow	chem/fallow			
Wunkar	14.8	15.2	14.7			
variety	Molineux	Suneca	Janz	RAC820		
Minnipa	14.9	14.7	14.5	14.7		
Wunkar	15.0	14.8	14.7	15.0		
N treat	zero	15 kgN	30 kgN	45 kgN	15,15t	15,15a
Minnipa	13.9	14.3	14.7	14.8	15.0	14.2*
Wunkar	14.5	14.8	15.0	15.2	15.0	14.8

* Note: The 15 kg addition at anthesis was not made because of the sudden finish to the season. 15a=15 kgN at anthesis, 15t=15 kgN at tillering.

Conclusions

The grain yield results obtained after the first two years of management trials do not support the use of high rates of N at either seeding or as a split dressing in the low and unreliable rainfall environments of the upper Eyre Peninsula and northern Murray Mallee. The protein data for 1996 lends further support to this conclusion as the protein figures were all well above the minimum 13% even with zero application of

N. Of the rates used in this research, 15 kg/ha at seeding would appear to be justified except in very poor seasons such as that experienced at Cungena in 1997.

The variety Janz, which is received into the Prime Hard pool in northern NSW, has performed well in both years at most of the sites. Molineux yielded poorly, except at Minnipa in 1997 when there were unseasonal late rains.

The success of fallowing (chemical/mechanical) supports the view that moisture conservation is critical to achieve improved yields in these low rainfall environments.

Table 4: Mean 1000 grain weight g at Minnipa and Wunkar in 1996

pre-treat	medic	mech/fallow	chem/fallow			
Wunkar	28.5	28.3	28.4			
pre-treat	vetch	oats	chem/fallow			
Minnipa	30.7	30.2	29.7			
variety	Molineux	Suneca	Janz	RAC820		
Wunkar	26.3	30.4	27.1	29.9		
Minnipa	30.1	32.0	28.5	30.1		
N treat	zero	15 kgN	30 kgN	45 kgN	15,15t	15,15a
Wunkar	28.3	29.0	29.4	28.3	27.1	28.0
Minnipa	29.3	30.3	30.7	30.4	30.1	30.4*

* Note: The 15 kg addition at anthesis was not made because of the sudden finish to the season. 15a=15 kgN at anthesis, 15t=15 kgN at tillering.

The major agronomic problems associated with the production of Prime Hard in these regions are low yields and short grain filling periods which can result in low 1000 grain weight.

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References

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