Durum wheat-a profitable crop for Western Australia

Shahajahan Miyan[1] and Wal Anderson[2]

[1]Centre for Cropping Systems, Department of Agriculture PO BOX 483, Northam, Western Australia 6401
Email smiyan@agric.wa.gov.au
[2] Department of Agriculture, Albany Regional Office, 444 Albany Highway, Orana, Albany, WA 6330
Email wanderson@agric.wa.gov.au

Abstract

Field trials were conducted at Mukinbudin comparing rotations and nitrogen rates, and at Narembeen, comparing two durum wheat varieties to one bread wheat, at two nitrogen rates. Both sites used farm scale machinery on soil types and rotations common in the region. At Mukinbudin, there was no significant effect of the N application on grain yield, 1000-grain weight or gross margin despite the increase in grain protein. It appears that an N application of less than 25 kg/ha would have ensured protein sufficient to achieve the DR1 grade (13% protein), thus maximising the gross margin. Splitting the N application between sowing and tillering did not increase either yield or protein at either site. At Narembeen, Machete out-yielded the two durums, but only Wollaroi responded significantly to the addition of N fertiliser. Grain protein was also increased by N fertiliser, lifting the level in both durums to DR2 (11.5% protein), but 35 kg/ha was insufficient to increase protein in Machete to the level required for Australian Hard (11.5% protein). The relatively low legume content in the previous pasture year could probably explain the disappointing contribution of the medic pasture to grain protein at this site. Despite the lower grain yield of Wollaroi its gross margin at 35 kg/ha of N was as good as that of Machete. This illustrates the capacity of durum to achieve equal or better returns than bread wheat where soil and rotational conditions suit. These results, and our previous experience, lead us to suggest that durum wheat production does not require extra costs or greater management skill but can have higher returns compared to bread wheat if appropriate agronomic management is used.

Key Words

Durum wheat, and profitability

Introduction

One of the major concerns for durum growers in Western Australia is producing grain at a protein level that will qualify for a premium. The inherent soil fertility is generally too low to produce high grain protein in most seasons so rotation with legumes, high application rates of nitrogen fertilizer, or the use of fallow are possible systems to improve grain protein percentage. It has been recognised that adoption of grain legumes in farming systems can significantly increase cereal yields in the following year (Edward and Haagensen, 2000). The benefit of growing leguminous crop in a rotation include weed and disease management, soil structural benefits, erosion control and nitrogen nutrition for following crops (Chatel and Rowland, 1982). Prices for durum wheat can be higher compared to bread wheat when farmers achieve grain protein over 11.5% (DR1 or 2 grades), but similar to bread wheat where protein is lower. Durum wheats have been grown in different locations with mixed success for a long time in WA. The aim of the trials was to develop recommendations for the management of grain yield and quality based on rotations and N-fertiliser strategies.

Methods

Three experiments were conducted in 2001. At Mukinbudin experiments were conducted on a clay soil following lentils (site A) and a loam soil following a chemical fallow (site B). At Narembeen (site C) the experiment was conducted on a clay soil following a poor medic pasture. Both trials used farm scale machinery on soil types and rotations common in the region. Site details and crop rotations are presented in Tables 1 and 2.

Table 1. Details of the experimental sites at Mukinbudin and Narembeen in 2001

Site	Soil Type	Topsoil pH ($CaCl_2$)	P-Colwell (mg/kg)	Organic Carbon (%)	April-October Rainfall (mm)
A.Mukinbudin	Clay	6.8	19	0.63	161
B.Mukinbudin	Loam	7.1	12	0.70	161
C.Narembeen	Clay	7.9	18	1.21	207

Table 2. Crop rotation details of the trial sites, 1997-2000

Site	1997	1998	1999	2000
A.Mukinbudin	Medic Pasture	Bread wheat	Bread Wheat	Lentil
B.Mukinbudin	Pasture	Bread wheat	Bread Wheat	Chemical Fallow
C.Narembeen	Medic Pasture	Bread wheat	Bread Wheat	Poor Medic Pasture

The Mukinbudin trials were sown on May27 - with Tamaroi durum wheat. The plots were completely randomised with three replications, and five levels of N (0, 25, 50, 25 at seeding +25 at tillering,

60 kg/ha of N). All N was applied as urea at seeding.

At the Narembeen site Tamaroi and Wollaroi durum and Machete bread wheat were sown on May 18. The experiment was laid out as a completely randomised design with three replications. Urea was applied at seeding at either 0 or 35 kg/ha of N.

Seeding rates were calculated using percentage germination and mean 1000-grain weight to achieve the target plant density of 150/m^2. Each plot was 13.3 m wide by 200 m long, in site A and B and

8.5 m*100 m in site C. Weeds were controlled using appropriate pre- and post emergent herbicides. Grain yield, mean kernel weight grain protein (using the Near Infra-red Reflectance method) and gross margins of the treatments are reported in this paper. Analysis of variance was carried out using Genstat for Windows 5th edition.

Prices used for calculation of gross margins were based on the relevant payment scales of AWB Limited allowing for the relevant protein percentages and screenings at the time of harvest in 2001.

Results and Discussion

There was substantial summer rainfall at both sites prior to sowing. Using an estimate of 20% storage there was about 23 mm at Mukinbudin and 19 mm at Narembeen available to the crops at sowing. Rainfall in the growing season (Table1) was close to the long term average for both sites but its distribution was unusual. Low rainfall after sowing placed the crops under severe stress (worse at Narembeen) but good rains in July and good finishing rains allowed the crop to fill its kernels.

Results in Table 3 show that there was no significant effect of the N application on grain yield, kernel weight or gross margin despite the increase in grain protein. Thus adequate protein levels (DR1, >13%) in durum grain were achieved following a fallow with only 25kg/ha of N (site B) but additional N was required to achieve sufficient protein for the DR1 grade following the lentil crop (site A). Only low rates of nitrogen (say 20 – 40kg/ha) would be recommended in order to ensure adequate protein levels and maximum gross margins in durum wheat. Splitting the N application between sowing and tillering did not increase either yield or protein at either site at Mukinbudin and so application at seeding appears advisable.

At Narembeen, Machete outyielded the two durums, but only Wollaroi responded significantly in grain yield to the addition of N fertiliser (Table 4). Grain protein was also increased by N fertiliser, lifting the level in both durums to DR2 (>11.5%), but 35kg/ha was insufficient to increase protein in Machete to the level required for Australian Hard (11.5%). The relatively low legume content in 2000 (declined to less than 50%) could probably explain the disappointing contribution of the medic pasture to grain protein at this site. Anderson et al. (1995) reported that wheat protein was lower than 11.5% (the minimum for AH grade) when pasture stands were less than 50% of legume. The stress during June at this site possibly reduced the responses to applied N and possibly also restricted uptake of legume N during a critical time for yield formation.

Table 3: Effect of chemical fallow and lentil on grain yield and quality of Tamaroi durum wheat at Mukinbudin, 2001

	Chemical Fallow				Lentil			
Treatment	Yield	Kernel Wt.	Protein	Gross margin	Yield	Kernel Wt.	Protein	Gross margin
	(kg/ha)	(mg)	(%)	($/ha)	(kg/ha)	(mg)	(%)	($/ha)
0N	2010	41	12.2	671	2325	45	11.9	760
25N	2034	43	13.2	696	2320	45	12.5	759
50N	2024	42	13.5	667	2360	45	14.3	840
25N+25N	2024	42	13.5	666	2352	45	12.9	766
60N	2054	42	13.5	663	2338	44	13.7	784
LSD:.05	NS	NS	0.9	NS	NS	NS	1.7	NS

Despite the lower grain yield of Wollaroi its gross margin at 35kg/ha of N was as good as that of Machete. This illustrates the capacity of durum to achieve equal or better returns than bread wheat where soil and rotational conditions suit. Previous experience has been that Wollaroi is slightly better adapted than Tamaroi in low rainfall areas such as those of these experiments (A. Impiglia, Pers. Comm.). This could explain the differences in response to N at this site.

Table 4: Effect of nitrogen fertiliser on grain yield and quality of durum and bread wheat at Narembeen, in 2001 following poor medic pasture.

Treatment	Yield (kg/ha)	Kernel Weight(mg)	Grain protein (%)	Gross margin ($/ha)
Machete N0	2770	42	8.7	573
Machete N35	2920	41	10.5	723
Tamaroi N0	2030	42	8.4	465
Tamaroi N35	1990	40	12.7	637
Wollaroi N0	2030	43	10	518
Wollaroi N35	2430	42	12.1	745
LSD:0.05	230	NS	1.1	65

Conclusions

These results confirm earlier experience from trials in the eastern wheat belt which have shown that if durum is grown on neutral to alkaline clay soils following good quality legume pastures or crops, its profitability will equal or exceed that from bread wheat. The risk of failing to meet the protein standards for DR1 or DR2 can be reduced by the addition of relatively low rates of N fertiliser which are usually more than repaid through the premiums obtained. The evidence from these trials, plus considerable data from bread wheat trials in the eastern wheat belt, indicates that the expectation of an economic return from split applications of N is low.

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