

MORLEY RESEARCH CENTRE

Nitrogen management strategies in durum wheat

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Summary

Nitrogen treatments (0, 100, 150, 200 and 250 kg/ha) as solid ammonium nitrate were applied in two or three-way splits to Lloyd durum wheat grown as first wheat on the sandy loam soil at Morley. Application dates for the two-way split were 23 April (GS 31) and 12 May (GS 33) with the three-way split also receiving nitrogen on 13 March (GS 22). Some of the treatments also received additional foliar urea (40 kg/ha) applied on 24 June (GS 71-73). Where no nitrogen was applied, the crop produced a yield of 3.37 t/ha. All nitrogen treatments significantly increased yield, although there was little response above 150 kg/ha N. Whilst yields tended to be lower with the three compared to the two-way splits, differences overall were not significant. Yields also tended to be slightly lower where liquid urea was applied on 24 June (GS 71-73). Where no nitrogen was applied, the crop had a specific weight of 80.7 kg/hl, with a grain protein content of 11.1%. Overall, specific weight was significantly reduced from an average of 80.4 kg/hl where 100 kg/ha N was applied to 79.2 kg/hl with 250 kg/ha as ammonium nitrate, but nitrogen timing had no significant effect. Grain protein contents were significantly increased following the application of nitrogen, from an average of 12.7% with 100 kg/ha of nitrogen to 15.0% with 250 kg/ha N as solid ammonium nitrate. Protein contents were also significantly higher with the two compared with the three-way split. The highest protein levels (15.5%) were with the application of 200 kg/ha N as solid ammonium nitrate followed by 50 kg/ha nitrogen as liquid urea on 24 June.

Object

To evaluate the effects of differing nitrogen management strategies in durum wheat on yield and quality.

Method

<i>Site</i>	Bullswood, Hall Farm, Morley Research Centre
<i>Soil type and series</i>	Sandy loam over chalky boulder clay (Ashley series)
<i>Variety</i>	Lloyd
<i>Treatments</i>	Details of treatments are given in Table 1
<i>Sowing date</i>	9 December 2002
<i>Husbandry</i>	Normal farm inputs excluding nitrogen
<i>Trial design</i>	Factorial with three randomised blocks
<i>Analysis</i>	ANOVA with LSD's quoted at P = 0.05
<i>Plot size</i>	12 m x 2.1 m with buffers
<i>Application</i>	Nitrogen treatments (100 or 250 kg/ha) as solid ammonium nitrate were applied by hand in two or three-way splits. The timings were 13 March (GS 22), 23 April (GS 31) and 12 May (GS 33). Additional nitrogen (50 kg/ha) was applied to some treatments on 24 June (GS 71-73) using a sprayer with dribble bars
<i>Experiment diary</i>	See Appendix
<i>Deviations from protocol</i>	<ul style="list-style-type: none"> • 1000 grain weight and hagberg were not determined

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*Not for publication without the consent of the Director of Morley Research Centre. This report deals primarily with only one year's work so any conclusions given are provisional

Results

Table 1. Grain yield (t/ha at 85% dm) and grain protein content (%)

	Nitrogen timing	13 March GS 22	23 April GS 31	12 May GS 33	24 June GS 71-73	Total N (kg/ha)	Grain yield (t/ha at 85% dm)	Protein (%)
1	2 way split	-	40	60	-	100	5.24	13.0
2	2 way split	-	60	90	-	150	5.58	14.2
3	2 way split	-	80	120	-	200	5.62	14.7
4	2 way split	-	100	150	-	250	5.46	15.1
5	3 way split	25	35	40	-	100	5.46	12.4
6	3 way split	50	40	60	-	150	5.61	14.1
7	3 way split	50	60	90	-	200	5.60	14.8
8	3 way split	50	80	120	-	250	5.67	14.8
9	2 way split	-	80	120	50	200 + 50	5.06	15.5
10	3 way split	50	60	90	50	200 + 50	5.25	15.5
11	Untreated	-	-	-	-	0	3.37	11.1
LSD							0.434	0.32
SE per plot (20 df) ±							0.255	0.19
CV (%)							4.8	1.3

- The crop followed sugar beet and was drilled on 9 December 2002.
- Establishment was relatively poor, with 168 plants/m² recorded when counts were made on 26 February 2003.
- The late drilling and dry spring conditions restricted tillering and the fertile tiller numbers recorded in late June ranged from 263/m² where no nitrogen was applied to 443/m² where 150kg/ha of nitrogen was applied in a three-way split, with the first dressing on 13 March (GS 22) (Table A1). Overall, there were significantly more fertile tillers when nitrogen was applied in a three-way split (417/m²) compared with a two-way split (386/m²).
- Where no nitrogen was applied, the crop produced a yield of 3.37 t/ha (Tables 1 and A1). All nitrogen treatments significantly increased yield, although there appeared little response above 150 kg/ha of nitrogen. Whilst yields tended to be higher with the three-way splits compared with the two-way, differences overall were not statistically significant. Yields also tended to be slightly lower where liquid urea was applied by dribble bar on 24 June (GS 71-73).
- Where no nitrogen was applied, the crop had a specific weight of 80.7 kg/hl with a grain protein content of 11.1% (Tables 1 and A1). Overall, specific weight was significantly reduced from an average of 80.4 kg/hl where 100 kg/ha N was applied to 79.2 kg/hl with 250 kg/ha of nitrogen as ammonium nitrate, but nitrogen timing had no real effect.
- Grain protein contents were significantly increased following the application of nitrogen, from an average of 12.7% with 100 kg/ha of nitrogen to 15.0% with 250 kg/ha N as solid ammonium nitrate (Tables 1 and A1). Protein contents were also significantly higher with the two compared with the three-way split. The highest

protein levels (15.5%) were with the application of 200 kg/ha N as solid ammonium nitrate followed by 50 kg nitrogen as liquid urea applied by dribble bar on 24 June.

Further details

Other experiment details and results are presented in the appendix.

Field details

Applications to crop

Experiment diary

Method

Results

Table A1 Fertile tillers (/m²), grain yield (t/ha at 85% dm), specific weight (kg/hl at 85% dm) and grain protein content (%)

Field details

Site	Hall Farm, Morley Research Centre		
Field reference	Bullswood		
Crop	Durum wheat		
Variety	Lloyd		
Previous crop	2002 Sugar beet 2001 Winter wheat		
Soil type and series	Sandy loam over chalky boulder clay (Ashley series)		
Soil analysis August 2003	pH	P	K Mg
	7.3	2+	1 0+
Seed rate	450 seeds/m ²		
Date sown	9 December 2002		
Cultivations	9 December 2002	Ploughed	

Applications to crop

Date	Item	Rate/ha
12 December 2002	Tolugan 700 (chlorotoluron, 700)	1.75 l
	+ Stomp 400 SC (pendimethalin, 400)	1.75 l
4 May 2003	Mirquat (chlormequat, 730)	2.2 l
	+ Topik (clodinafop-propargyl, 240)	0.1 l
	+ Cropspray 11E (adjuvant)	1.0 l
15 May	Landmark (epoxiconazole + kresoxim-methyl, 125 + 125)	0.5 l
	+ Duplosan KV (fmecoprop-P, 600)	1.5 l
	+ Ally (metsulfuron-methyl, 20% w/w)	0.03 kg
29 May	Landmark	0.5 l
	+ Corbel (fenpropimorph, 750)	0.2 l
	+ Terpal (2-chloroethylphosphonic acid + mepiquat chloride, 155:305)	0.5 l
	+ Non ionic wetter	0.06 l
10 June	Swing Gold (dimoxystrobin + epoxiconazole, 133 + 50)	0.5 l

Experiment diary

Date	GS	Treatments applied or action
9 December 2002		Trial drilled using Oyjord plot drill
26 February 2003	11	Assessment of plant population (168 plants/m ²)
13 March	22-23	First nitrogen application as per treatment list
23 April	30-31	Second nitrogen application as per treatment list
12 May	33	Third nitrogen application as per treatment list
24 June	71-73	Late foliar nitrogen application as per treatment list Weather conditions cloudy and mild (16°C) Assessment of fertile tiller population
4 August	92	Trial harvested using Sampo 2010 "R" plot combine

Spray and assessment methods for cereal trials

This is an abbreviated version of the standard operating procedures used at Morley Research Centre.

Plot layout

Plots were sown at 450 seeds/m² with an Oyjord drill. The drilled plots were 12 m long and 1.56 m wide from outside row to outside row (14 rows at 12.0 cm spacing). Plots were separated by a buffer of the same size with a 54 cm gap between successive plots and buffers. This gave an effective plot width of 2.10 m, which was used for harvest yield calculations. Treatments were applied to the plot and to half of the buffer at each side. For harvest purposes, plot length was reduced to 9.0 m.

Overall treatments

Overall treatments of insecticides, herbicides, fungicides and growth regulators were applied across all plots with farm machinery using wheelings, 24 m apart.

Fertiliser application details

Solid treatments were pre-weighed and applied by hand as evenly as possible across the plots.

Liquid treatments were applied using a CO₂ powered backpack sprayer, utilising 'Comelius' vessels and a 4 m boom (eight Billericay dribble bars at 0.5 m spacings)

Agronomic factors

Plant population was determined by making 30 counts of a 30.5 x 30.5 cm quadrat at random across the site.

Fertile tiller population was determined by recording the number of ears in six 30 x 30 cm quadrats per plot.

Harvest details

Plots were harvested using a Sampo 2010 combine which was modified for plot work and used electronic weighing and moisture determination (Harvest Master HM-400 with Grain Gauge). Trials were harvested by replicate.

Post harvest determinations

The grain samples were pre-cleaned using a Rational sample cleaner to remove any chaff or straw before further assessments (specific weight grain protein content) were carried out.

Specific weight and grain protein content were determined using a FOSS Infratec 1241-050 grain analyser.

Table of results

Table A1 *Fertile tillers (/m²), grain yield (t/ha at 85% dm), specific weight (kg/hl at 85% dm) and grain protein content (%)*

Treatment	Fertile tillers	Grain yield	Specific weight	Protein
-		at 85% dm	at 85% dm	Dumas
Unit	/m ²	t/ha	kg/hl	%
Date	24/06/2003	04/08/2003		
1	362	5.24	80.3	13.0
2	402	5.58	80.0	14.2
3	369	5.62	79.9	14.7
4	411	5.46	78.8	15.1
5	405	5.46	80.5	12.4
6	443	5.61	80.0	14.1
7	390	5.60	79.5	14.8
8	430	5.67	79.6	14.8
9	421	5.06	78.8	15.5
10	409	5.25	79.0	15.5
11	263	3.37	80.7	11.1
LSD (P=0.05)	50.8	0.434	0.89	0.32
SE per plot (20 df)±	29.9	0.255	0.53	0.19
CV (%)	7.6	4.8	0.7	1.3