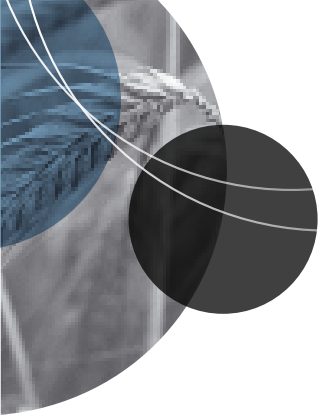

Irrigation & climate

Barley irrigation and seeding rate

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Key findings

- In the wet winter of 2016, a single irrigation of a barley crop increased grain yield and grain quality but resulted in reduced water productivity.
- The 50 kg/ha seeding rate improved grain quality and reduced lodging compared with the 80 kg/ha seeding rate with no negative impact on grain yield.
- The waterlogged treatment (ponded for 48 hours) used an additional 0.41 ML/ha or 55% more water in one irrigation than the treatment that was ponded for only five hours.

Introduction

In 2016, an experiment was conducted at Leeton to investigate the irrigation water requirements of a barley crop and the impact that plant density, nitrogen (N), irrigation intensity and waterlogging have on grain yield and quality, water use and water productivity.

Site details

Location	Leeton
Soil type	Self-mulching heavy clay
Previous crop	Wheat
Sowing	20 May (disc drill at 18 cm row spacing)
Variety and seeding rates	La Trobe(1), 50 kg/ha and 80 kg/ha seed
Establishment	50 kg/ha – 90 plants/m^2 80 kg/ha – 160 plants/m^2
Sowing fertiliser	Di-ammonium phosphate (DAP), 125 kg/ha sown with seed
Topdressed nitrogen	8 August (Z32) – 0, 50, 100 and 150 kg N/ha
In crop rainfall	402 mm
Irrigation date	27 October

Treatments

Irrigation management treatment

There were three irrigation treatments (T) and four replicates in each treatment:

T1 – Rainfed (no irrigation)

T2 – Irrigated not waterlogged – one spring irrigation ponded for 5 hours before draining

T3 – Irrigated waterlogged – one spring irrigation ponded for 48 hours before draining.

Each of the irrigation treatments were in separate bays to allow water use to be accurately measured. Irrigation was applied to the two irrigated treatments on the same day.

Seeding rates

Each irrigation treatment was split for seeding rate treatments of 50 kg/ha and 80 kg/ha.

Nitrogen treatment

Four N treatments of 0, 50, 100, 150 kg N/ha were applied to each irrigation/seeding rate treatment at stem elongation (Z32).

Results

Grain yield

The rainfed treatment had a significantly lower grain yield than either of the irrigated treatments, but the difference was relatively small (0.27 t/ha) (Table 1). This small difference is likely due to the large amount of rainfall (402 mm) received during the growing season.

There was no significant difference in grain yield between the 50 kg/ha and 80 kg/ha seeding rates. The 80 kg/ha seeding rate treatment had higher dry matter and more tillers than the 50 kg/ha treatment, but this did not result in increased grain yield (Table 1). Despite the extended period of ponding, the waterlogged treatment grain yield was not significantly different from the non-waterlogged irrigation treatment.

Table 1. Growth, grain yield, grain quality and water productivity response of barley to irrigation, seeding rate and N topdressing in an experiment at Leeton in 2016.

Treatment		Total dry matter (kg/ha)	Tiller number (No/m^2)	Grain yield (t/ha)	Lodging score 1=standing, 9=flat	Grain protein (%)	Retention >2.5 mm (%)	Screenings <2.2 mm (%)	Water productivity (t/ML)
Irrigation	Rainfed	1282	813	6.15	4	9.77	73	9.3	1.53
	Non-waterlogged	1342	818	6.42	3	9.65	81	6.0	1.35
	Waterlogged	1373	799	6.47	4	9.82	80	6.4	1.25
	l.s.d. (P<0.05)	n.s.	n.s.	0.20	n.s.	n.s.	2	0.6	0.05
Seeding rate	50 kg/ha	1315	749	6.33	3	9.76	80	6.7	1.37
	80 kg/ha	1349	871	6.35	4	9.74	76	7.7	1.38
	l.s.d. (P<0.05)	30	46	n.s.	0.4	n.s.	2	0.9	n.s.
Topdressed nitrogen (kg N/ha)	0	870	552	4.32	2	8.26	91	2.3	0.93
	50	1332	777	6.49	4	8.81	85	4.1	1.41
	100	1505	927	7.06	5	10.21	72	9.5	1.53
	150	1621	983	7.49	5	11.71	64	13.0	1.63
	l.s.d. (P<0.05)	51	57	0.31	0.4	0.23	2	0.8	0.07

Water use & water productivity

The rainfed treatment received 4.0 ML/ha from rainfall during the growing season, while the non-waterlogged and waterlogged treatments received an additional 0.74 ML/ha and 1.14 ML/ha respectively from their one irrigation. The waterlogged treatment, which was ponded for 48 hours, used an additional 0.41 ML/ha or 55% more water than the single irrigation treatment, which was ponded for five hours. The increased water use associated with waterlogging was primarily due to increased infiltration over the extended period of ponded water.

The rainfed treatment had the highest water productivity of 1.53 t/ML compared with 1.35 t/ML and 1.25 t/ML for the one irrigation and waterlogged treatments respectively (Table 1).

While seeding rates had no significant effect on water productivity, applying N at stem elongation significantly increased water productivity (Table 1). There was a significant interaction between irrigation treatment and N topdressing rate for water productivity (Figure 1).

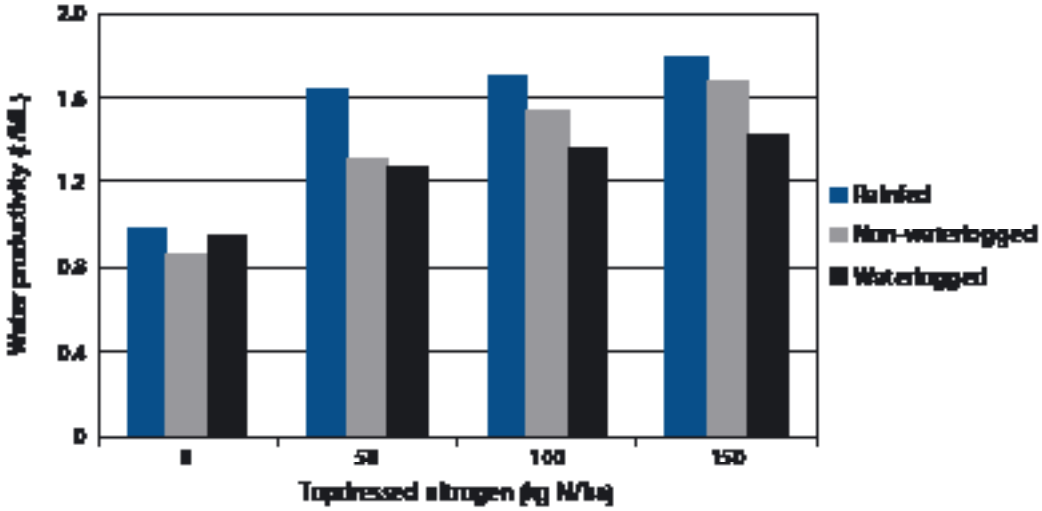

Figure 1. Water productivity (t/ML) of barley with three irrigation and four N treatments, averaged across seeding rate; l.s.d. (P<0.05) = 0.11.

Lodging

Lodging was a problem in winter crops in the 2016 season due to the very wet conditions. Although irrigation treatment had no effect on lodging, the higher seeding rate (80 kg/ha) resulted in significantly increased lodging compared with the lower seeding rate (50 kg/ha) (Table 1). The increased rate of topdressed N also significantly increased lodging (Table 1).

Grain quality

Grain protein increased significantly with higher rates of topdressed N, but was not affected by either irrigation treatment or seeding rate (Table 1).

The non-irrigated rainfed treatment produced lower grain quality than either of the irrigated treatments when averaged across seeding rate and nitrogen treatments. The rainfed treatment had significantly lower seed retention (>2.5 mm) and significantly higher screenings (<2.2 mm) than the two irrigated treatments. The 80 kg/ha seeding rate had smaller grain size, lower retention and higher screenings than the 50 kg/ha seeding rate (Table 1).

Increased rates of topdressed N significantly reduced grain retention and increased screenings, demonstrating a significant interaction between irrigation treatment and N rate (Figure 2). As the N topdressing rate increased, the percentage of screenings increased more for the rainfed treatment, than the two irrigated treatments (Figure 2).

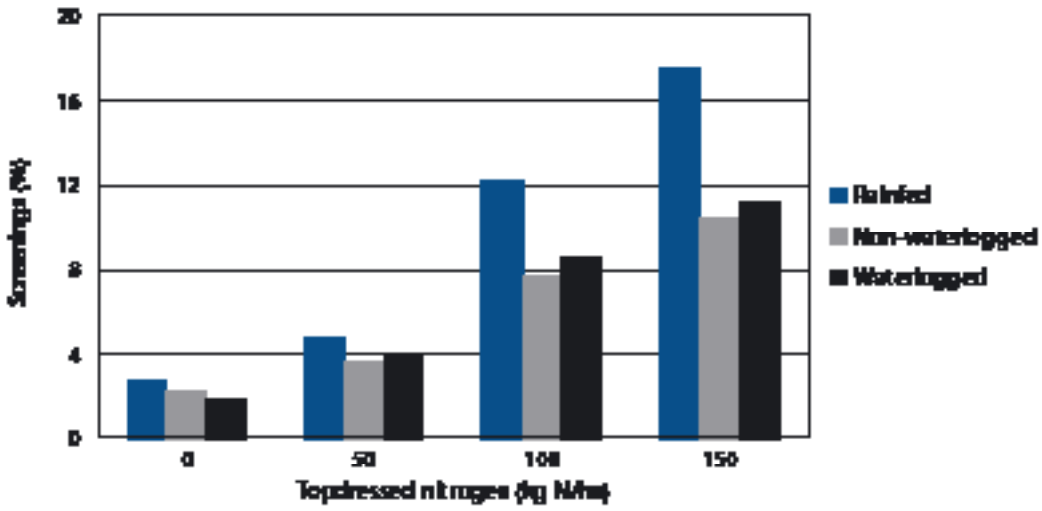

Figure 2. Grain screenings <2.2 mm (%) for seeding rate by N interaction, averaged across N treatments; l.s.d. (P<0.05) = 1.33.

Summary

The 2016 winter was particularly wet, with many commercial cereal crops suffering from severe waterlogging. The experimental site had acceptable surface drainage and soil structure, which resulted in little surface water ponding on the plots for any extended period of time, thus high grain yields were still able to be obtained.

The wet winter also resulted in the cereal crops having very shallow root systems, so when evapotranspiration rates increased in spring and rainfall slowed, the crops quickly suffered from moisture stress. Adding one irrigation did not produce a large increase in grain yield, but the benefit was obvious in grain quality, particularly at high N rates. Grain quality is a very important component in profitability with poor grain quality often resulting in lower prices in the marketplace.

Many growers use higher seeding rates than are required to achieve high grain yields. The current recommended seeding rate for barley with partial and full irrigation is 60–90 kg/ha and 70–110 kg/ha respectively. The results of this experiment are an example of a lower seeding rate producing equivalent grain yield, with the added benefits of improved grain quality and reduced lodging. Seeding rate recommendations for irrigated barley should be reviewed following further research conducted with a range of irrigation intensities.

Acknowledgements

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