EFFECT OF PERENNIAL PASTURE TYPE ON YIELD AND PROTEIN CONTENT OF IRRIGATED WHEAT

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Summary. Irrigated wheat was direct drilled following 4 years of irrigated perennial pastures. The three pasture types were *pure* white clover, white clover/paspalum/perennial ryegrass mixture, or lucerne. The wheat was topdressed with 4 rates of nitrogen (0, 40, 80 or 120 kg N/ha) at mid-tillering (DC15; DC23). Although dry matter production following lucerne was highest at the time of topdressing, by anthesis DM production was highest following clover. Grain yield was also significantly higher following clover (8.2 t/ha) than following lucerne (7.5 t/ha). The clover/grass mixture produced a substantially lower yield (4.6 t/ha). The topdressed N rate had a significant effect on all the production parameters measured in the experiment. Although DM production and grain yields were high there was no lodging. The low protein levels (7-9%) were probably due to the high yields achieved and the need for 8 irrigations.

INTRODUCTION

A preceding pasture phase is known to have a favourable effect on a cereal crop, the benefits usually being attributed to increased availability of nitrogen, improved physical properties of the soil or both (1). In one study at Deniliquin yield of wheat following perennial pasture (white clover) was 49% greater than after annual pasture (subterranean clover) (1). Under rainfed conditions, at Tamworth wheat production for several years following lucerne exceeded that following fallow or continuous wheat (2). An experimental site at Yanco provided the opportunity to measure the performance of irrigated wheat following several years of white clover, lucerne or a white clover/grass mixture.

MATERIALS AND METHODS

Irrigated wheat was grown following 4 years of irrigated perennial pasture. The 3 pasture types, *pure* white clover, white clover/paspalum/perennial ryegrass mixture, and lucerne were sown on 18 September 1989. Following an establishment period (1989-90), the pasture was subjected to a range of irrigation frequencies for 4 growing seasons. Pasture production was measured during the spring - summer - autumn period of each season. The final pasture cut on 21 March 1994 was followed by a heavy grazing with sheep.

The site was pre-irrigated on 9 May, pasture regrowth sprayed and then wheat cv. Janz direct drilled (0.15 m row spacing) on 26 May. Seeding rate was 150 kg/ha and 100 kg/ha of MAP (22% P, 10% N) was applied with the seed. All plots were topdressed with 4 rates of nitrogen (0, 40, 80 or 120 kg N/ha as urea) at mid-tillering (DC15, DC23 (3)) on 4 August with the first spring irrigation applied on the following day. Drought conditions (54 mm of rain from topdressing to harvest) necessitated another 7 irrigations which were scheduled against cumulative ET_o. Dry matter production at anthesis and maturity was assessed from a single quadrat (6 rows x 1 m) per plot. Plant height was measured at anthesis and head number also counted on the quadrat. Grain yield was measured from 1.8 x 8 m using a small plot header, and a sample of the harvested grain was used to measure individual grain weight and grain protein.

The soil was a Birganbigal clay loam (4), Dr 2.23 (5) with a clay loam surface horizon 0.15-0.20 m deep and a heavy clay subsoil. There were 4 replicates and as there were few statistically significant effects of irrigation frequency on the wheat parameters measured, results are presented as means of irrigation frequencies.

RESULTS

Pasture production

A summary of the first 2 years has been reported previously (6). Well above average rainfall in 1992-93 negated any effect of irrigation frequency however production levels in 1992-93 and 1993-94 were similar to those reported for 1991-92, 20 t/ha from lucerne and 14 t/ha from clover.

Wheat establishment

Plant establishment (350/m^2) was more than adequate for high yield potential and was not significantly affected by pasture type or irrigation frequency of the pasture.

Dry matter production

At the time of topdressing, wheat following lucerne had produced twice the dry matter of that following clover/grass mixture, with production following clover being intermediate (results not presented). At anthesis, wheat following clover had produced significantly ($P < 0.001$) more than following lucerne which was significantly greater than wheat following the clover/grass mixture (Table 1). Each increment in N rate produced a significant increase in dry matter at anthesis (Table 2).

At maturity wheat following clover or lucerne had produced 16.5 t/ha of dry matter, significantly more than the 10.4 t/ha from wheat following the clover/grass mixture.

Table 1. Production parameters for wheat following perennial pasture type (mean of N rates).

Treatment	DM at anthesis (t/ha)	Head number (m^2)	Height (cm)	Grain yield (t/ha)	1000 gr. wt. (g)	Protein (%)
Clover	12.5	695	93	8.2	34.5	8.9
Lucerne	11.2	705	89	7.5	35.0	8.6
Clover/grass	8.0	550	77	4.6	33.3	7.1
l.s.d (P=0.05)	1.0	65	2	0.5	0.5	0.3

Plant height

Wheat following clover was significantly ($P<0.001$) taller than following lucerne and both were significantly taller than following the clover/grass mixture. Each increment in N rate produced significantly taller plants (Table 2). There was no lodging.

Head number

There was no difference in head number following clover or lucerne but both were significantly ($P<0.001$) higher than following the clover/grass mixture (Table 1). Each increment in N rate produced significantly more heads (Table 2).

Grain yield (12% moisture)

The grain yield following clover was significantly (P<0.001) higher than following lucerne. (Table 1). The yield following the clover/grass mixture was much lower than following either of the pure swards. Each increment in N produced a significant increase in grain yield (Table 2). The highest grain yield of 8.8 t/ha was produced following clover topdressed with 80 kg N/ha, whilst the lowest yield (3.5 t/ha) followed the clover/grass mixture with zero topdressed N.

Table 2. Effect of N rate on production parameters for wheat following perennial pastures (mean of pasture type).

N rate	DM at anthesis (t/ha)	Head number (m^2)	Height (cm)	Grain yield (t/ha)	1000 gr. wt. (g)	Protein (%)
0	8.8	570	83	6.0	35.2	7.8
40	10.5	640	87	6.8	34.8	8.1
80	11.1	675	90	7.5	34.0	8.5
120	11.8	715	92	7.9	33.5	9.0
l.s.d (P=0.05)	0.6	34	2	0.3	0.4	0.2

Individual grain weight

Although there were statistically significant treatment effects on individual grain weight (Tables 1 and 2) the differences were not of any practical importance.

Protein level

Protein levels followed the same trend as grain yield with all differences for both pasture type and N rate being significant (P<0.001).

DISCUSSION

The grain yield level of 8.8 t/ha was equal to that recorded in other high yielding irrigated field experiments (7, 8, 9). A yield of 7.5 t/ha following clover with only 10 kg N/ha applied at sowing indicates that the soil N status following the pasture phase was high. Corresponding yields from lucerne and clover/grass mixture were 6.4 t/ha and 3.5 t/ha respectively. Yields following either legume were substantially higher than following the clover/grass mixture, presumably because of increased availability of soil N.

Despite grain yields approaching 9 t/ha there was no lodging. Dry matter production at anthesis (up to 14 t/ha for individual treatments) was substantially higher than the level of 9 t/ha indicated to pose severe lodging risks (8). Direct drilling of the crop would have provided firm anchorage for the plants even immediately following irrigation. The duplex soil when cultivated, is conducive to lodging particularly when moderate to strong winds occur when the soil is saturated during substantial rainfall or irrigation.

The relatively low protein levels were probably influenced by the high yields achieved and the need for 8 irrigations. The N uptake in the grain was 120 kg/ha following clover and 107 kg/ha following lucerne. The 120 kg is equivalent to a 4 t/ha crop at 17% protein or a 5 t/ha crop at 14% protein.

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