Turnip dry matter yield and water use efficiency under different irrigation regimes in western Victoria

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Abstract

Turnip dry matter (DM) yield and water use efficiency (WUE), were determined over a two year period under different irrigation regimes. Treatments comprised a dryland control (A), fully watered to soil field capacity per week (B), 75% of full watering (C), 50% of full watering (D), 25% of full watering (E), once off watering to soil field capacity between weeks 0-6 (F), weeks 6-8 (G), weeks 8-10 (H) and weeks 10-12 (I). Responses to applied water differed across years with significant responses to weekly irrigation regimes in year 1. In year 2, DM yields from all treatments were similar. Water use efficiencies varied (20 – 48 kg DM/mm/ha) with higher values being observed in year 2. The findings indicate that there is potential to economically irrigate turnips to provide additional DM, however issues such as sowing dates and insect damage will also influence final yields. In particular, temperatures during summer will influence responses to irrigation.

Key Words

Forage crops, nitrogen

Introduction

Under rainfed conditions in southern Australia, forage crops such turnips can be used to fill the summer feed gap. They are used within a pasture renovation program as a break crop to improve weed control and seedbed preparation. The feed produced helps defray the cost of the pasture renovation process. It has been estimated that such crops are grown on 70% of dairy farms in dryland dairy areas of Victoria with average yields of 9.5 t DM/ha in Gippsland and 5 t DM/ha in western Victoria. Unlike winter crops, there is no certainty of sufficient effective rainfall during the growing period for such summer forage crops, particularly in western Victoria. Irrigation has the potential to minimise variability in turnip DM production and make such crops a more reliable feed source. There is little information regarding the responsiveness of turnips to irrigation, appropriate irrigation scheduling, or comparing irrigated turnips to dryland turnips.

Methods

The two year study was undertaken on a commercial dairy farm at Ecklin (38?23'S.; 142?55'E) on a heavy clay loam soil derived from quaternary basalt. Sowing dates were 28 November and 24 December for years 1 and 2 respectively. Experimental plots were laid out in a randomised block design with 4 replicates. Within each block 9 treatment plots (12m x 12m) were allocated randomly. Irrigation water was applied to a turnip crop at either weekly intervals with differing water volumes (100%(B), 75%(C), 50%(D), 25%(E) of requirement) or once off waterings at different stages of growth (4-6(E), 6-8(F), 8-10(G), 10-12(H) weeks) during the growing period. A dryland control (A) was also included. Plots were further subdivided in half, each half receiving either 0 or 50 kg N/ha applied as Urea (46% N) approximately 5 - 6 weeks after sowing. Determination of weekly water requirements was based on soil moisture measurements with 100% water allocation being adequate to return soil moisture back to field capacity. Statistical analysis for DM yield and WUE was conducted using analysis of variance (1)

Results

In year 1, total, leaf and root DM yields for treatments B, C and D were significantly ($P<0.05$) higher than for treatment A (Table 1). Leaf DM yields for treatments G and H were also significantly ($P<0.05$) higher

than treatment A, whilst root DM yields for both treatments H and I were significantly (P<0.05) higher where N was applied. In contrast, in year 2 there was no effect of treatment or N application on final DM yield, although where N was applied leaf DM yield was significantly (P<0.05) higher. Leaf to root ratios were significantly higher (P<0.05) for treatments C, D, G and H compared to treatment A. In year 1, WUE for treatment A was significantly (P<0.05) higher than treatments B, C, D and E irrespective of N application and for treatment F without N and treatment G with applied N. In year 2 treatment A had a significantly (P<0.05) higher WUE compared to all other treatments. Responses to applied water on a weekly basis in year 1 ranged from 12.1 to 14.3 kg DM/ha mm^{-1} and in year 2 from 3.5 to 4.5 kg DM/ha mm^{-1}.

Table 1. Dry matter yield (t DM/ha) and water use efficiency (WUE) (kg DM/ha.mm^{-1}) for total water received and soil moisture extracted at 30 cm for turnips crops receiving different volumes of irrigation water, with (50 kg N/ha) or without applied nitrogen (6 weeks after sowing) in years 1 and 2

		Year 1		Year 2	
Trt	(kgN/ha)	DM Yield	WUE	DM Yield	WUE
A	0	5.14	33.64	8.89	49.72
	50	4.94	31.41	9.36	49.98
B	0	9.83	20.09	10.30	30.10
	50	10.34	21.24	10.30	30.21
C	0	8.35	19.64	8.80	28.23
	50	8.61	20.84	9.91	31.54
D	0	8.65	25.76	9.78	34.39
	50	8.40	24.77	10.39	39.00
E	0	6.23	26.18	9.28	42.01
	50	5.81	23.46	9.99	44.78
F	0	4.86	26.06	8.93	42.22
	50	5.40	27.54	8.93	42.70

G	0	5.99	29.01	9.67	43.89
	50	5.10	25.63	8.97	41.51
H	0	6.00	31.12	9.61	43.20
	50	6.44	31.82	9.67	43.54
I	0	5.30	27.36	8.60	39.32
	50	6.12	29.66	9.25	40.61
l.s.d. (P=0.05)		1.117	4.820	1.379	6.650

Conclusion

Previous studies (2) have shown that turnips can be tolerant of high temperatures providing adequate moisture is available. The results from this study tend to support this finding with lower temperatures in year 2 allowing dryland crops to better express growth potential even where moisture may have been potentially limiting. Although average temperatures in year 1 were approximately 5?C higher than in year 2, daily maximum temperatures in year 1 often exceeded 30?C leading to considerable wilting of crops, particularly the dryland treatment. It is likely that this significantly reduced DM yield of the dryland treatment. Furthermore once off irrigation of turnip crops during the growing period did not significantly increase DM yields over a crop grown under dryland conditions.

References

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