Planting density effects on the growth, yield and water relations of wheat

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Recent studies have suggested that early growth determines the yield of spring wheat under Mediterranean climatic conditions. The present study was initiated to determine whether increased planting density to stimulate early dry matter production also increases yield.

Methods

Wheat (Triticum aestivum L. cv. Gutha) was sown at 25, 50, 100 and 200 pl. m-^{2} in a randomized complete block design with four replications in the field at CSIRO, Floreat Park. Plots were under a rainout shelter that could be positioned to automatically cover plants when it rained. Plants were subjected to two drying cycles, the first from 0 to 15 d and the second from 25 to 55 d after anthesis. Midday leaf water potentials and stomatal conductances were measured during the drying period using a pressure chamber and porometer. Soil moisture content was determined using a neutron moisture meter. Light interception by the crop canopy was measured from 52 to 113 d after sowing (DAS) using a linear quantum sensor. Dry matter production and leaf area were determined at anthesis. Grain yield and yield components were determined at maturity.

Results and discussion

Results obtained are summarized in Table 1. At low planting densities light interception and LAI were lower and resulted in lower dry matter production at anthesis. After withholding water, leaf water potentials decreased earlier and more severely in wheat sown at high density than at low density. Significantly lower stomata! conductances occurred in wheat at high planting densities. Although increasing the planting density from 25 to 200 pl. m-^{2} increased grain yield by 22%, wheat at 50-200 pl. m-^{2} did not give significant differences in yield. Grain weight was not significantly affected by planting density. Cumulative water use was significantly lower in the low density plots at anthesis, but by maturity total water use was similar in all treatments.

Table 1. Means of percentage light interception (LI), leaf area index (LAI) and total shoot dry matter (DM) at anthesis; leaf water potential (LWP) and stomatal conductance (k_s) at 98 DAS; grain yield (GY), grain weight (GW) and cumulative water use (CWU) at maturity.

Plant density	Anthesis (85 DAS)			98 DAS		Maturity (140 DAS)		
	LI	LAI	DM	LWP	k_s	GY	GW	CWU
(pl.m^{-2})	(%)	(m^{2}m^{-2})	(g m^{-2})	(MPa)	(mmol m^{-2}s^{-1})	(g m^{-2})	(mg)	(mm)
25	46.4^{b}	0.58^{b}	94^{c}	-2.34^{a}	107^{a}	109.7^{b}	23.9	308
50	53.5^{b}	0.82^{a}	142^{b}	-2.49^{a}	96^{a}	132.9^{a}	24.0	318
100	64.5^{a}	0.96^{a}	173^{a}	-2.85^{b}	74^{bc}	138.9^{a}	25.0	312
200	61.8^{a}	0.84^{a}	189^{a}	-2.99^{b}	66^{c}	134.0^{a}	26.6	312
LSD(.05)	8.20	0.178	32.3	0.163	28.8	12.44	NS	NS
CV (%)	9.1	13.9	13.5	3.8	20.6	6.0	9.2	1.5

High planting density had no influence on yield despite 22-33% greater dry matter by anthesis. Despite the greater water use at anthesis in the higher densities and the greater degree of water deficits at these densities, yields were unaffected. This confirms previous observations that water deficits near anthesis do not necessarily reduce yields (1).

1. Turner, N. C., Tennant, D., Hablin, A. P., Henson, I.E., Jensen, C. R. and Perry, M. W. (1987). Proc 4th Aust. Agron, Conf. p254.