Selection techniques for improved yields and drought resistance of wheat

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In an environment where water becomes limiting after anthesis an effective ability to transfer assimilates from the stems and tillers to the grain is desirable (1). Earlier studies have shown that the chemical senescing agent potassium iodide (KI) sprayed on leaves and stems of wheat simulates post.anthesis drought (2). The aim of this study was to test whether KI at two different concentrations sprayed on whole plants simulated drought and whether grain yield rather than grain size of sprayed plants could be used to determine drought resistance.

Methods

In 1988 a trial was established at East Beverley in the eastern wheatbelt of WA (32?07'S, 116?65'E). Eleven wheat varieties were sown in 5 m^2 plots with 4 replicates of each treatment. Treatments consisted of irrigated, irrigated + 0.3% KI, irrigated + 0.6% KI and non.irrigated plots. KI was applied to wheat plants after anthesis when the grain in plots hadbdeveloped to approximately 1/3 grain fill. Grain yields and grain size (measured as the mean mass per grain of 500 grains) were measured after harvest. Reduction in grain weights due to the KI treatment and the absence of irrigation compared to irrigated plots were then determined.

Results and discussion

Results in Table 1 show that both KI treatments were more severe on average in reducing grain size and yield than withholding irrigation. This result is probably a reflection of the mild stress in the unirrigated plots due to good rainfall in the 1988 season, and MI was sprayed on heads as well as leaves and stems. When whole plants are treated with KI a concentration of 0.3% is considered adequate.

Correlations between non.irrigated and KI treated varieties for grain size and yields were poor, in contrast to similar experiments carried out at a lower rainfall site at Bruce Rock (31?89'S, 118?E) in 1985 and 1986(2). As East Beverley was not under stress, selection for drought resistance would not be possible without using a Method such as chemical desiccation to simulate drought conditions.

TABLE 1: Reduction in grain size and yield due to KI treatment and the absence of irrigation. (values are expressed as I reduction compared to irrigated plots)

VARIETY	% REDUCTION IN GRAIN SIZE -IRR	0.3% KI	0.6% KI	% REDUCTION IN GRAIN YLD -IRR	0.3% KI	0.6% KI
Bass	21.8	9.9	20.2	18.5	13.3	44.6
Condor	21.4	4.8	9.7	31.2	-0.1	25.8
Cranbrook	6.6	22.0	18.8	7.0	41.4	36.3
Egret	19.9	28.0	34.8	27.4	41.6	61.5
Eradu	15.4	24.6	43.7	15.3	53.2	66.0
Gutha	6.3	16.4	37.4	10.8	24.9	62.2
Halberd	7.5	10.0	29.8	0.7	26.7	46.2
Insignia	15.9	28.8	30.0	13.7	23.9	44.3
Kulin	6.2	18.8	30.9	13.6	37.5	67.7
Millewa	8.7	20.0	33.6	20.6	49.0	65.3
Tincurrin	15.9	9.6	16.7	18.6	11.8	31.3
Mean	13.2	17.5	27.8	16.1	33.2	50.1

Correlations between grain size and yields for the 0.3% KI and 0.6% KI treatments were 0.74 (P-0.004) and 0.90 (P<0.001) respectively, indicating that grain yield may be substituted for grain size for selection purposes. In terms of practical application this is important since measuring grain size is a tedious process.

1. Turner, N.C. and Begg, J.E. (1981) Plant and Soil 58:97.131.

2. Turner, N.C. and Nicolas, M. (1986) Proc. of an International Workshop, Capri, Italy, 27.31 October 1985: 203.215.