

SELECTION FOR WATER-USE EFFICIENCY IN GRAIN LEGUME SPECIES

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High water-use efficiency (WUE, total biomass/total water transpired) is a trait that should be associated with high biomass and seed yield, where water availability is limited. The substantial effort in measuring WUE has limited its use in plant breeding until recent research has shown that indirect measures of WUE can be provided by leaf carbon isotope discrimination (Δ) and specific leaf area (SLA)(1). This paper reports further work that has investigated the extent of variation in WUE found among genotypes of some important grain legumes, and its correlation with Δ and SLA.

MATERIALS AND METHODS

A field mini-lysimeter facility described elsewhere (1) was used to accurately measure total water transpired and total dry matter production (including root dry matter), and hence WUE in peanut, navybean, soybean and chickpea, over a 60-day period. A fully irrigated and stressed treatment was imposed on six contrasting genotypes of each species. Leaf Δ and specific leaf area (SLA)(cm² leaf/g dry leaf weight) were measured on leaf samples at the end of the period.

RESULTS AND DISCUSSION

Large genotypic variation in WUE, of the order of 40-60%, was observed in each species (Table 1), indicating there is significant scope for genetic improvement in drought tolerance via selection for this trait. The close relationship between WUE and Δ for peanut, navybean and soybean, especially under well-watered conditions, suggests Δ could be used as a simple screen for this difficult to measure trait. In peanut and navybean, it appears the simpler SLA measurement may provide a good correlated index of WUE. The lower WUE values in chickpea and soybean suggest further screening may be able to identify more diverse germplasm for use in future crossing programs.

Table 1. Genotypic range in WUE, and its relationship with Δ and SLA, for a range of grain legumes.

Crop	Treatment	Range in WUE (g/kg)	LSD (P<0.05)	Correlation (r) with Δ	Correlation (r) with SLA	Source
Peanut	Irrigated	2.46 - 3.71		-0.82	-0.86	Kingaroy, Aust.
	Stressed	1.81 - 3.15	0.38	-0.94	-0.92	
Navybean	Irrigated	2.26 - 3.57		-0.80	-0.86	Kingaroy, Aust.
	Stressed	2.38 - 3.87	0.55	n.s.	-0.87	
Soybean	Irrigated	1.66 - 2.44		-0.82	-0.70	Kingaroy, Aust.

	Stressed	2.03 - 2.78	0.66	-0.90	n.s.	
Chickpea	Irrigated	1.61 - 2.23		n/a	n.s.	Bangalore, India
	Stressed	1.94 - 2.73	0.30	n/a	n.s.	

n/a - not available yet, n.s. - non-significant

ACKNOWLEDGMENTS

This project is funded by the Australian Centre for International Agricultural Research (PN9216).

REFERENCES

1. Wright, G.C. and Nageswara Rao, R.C. 1994. Crop Sci. 34, 92-97.