Contribution of genetic change to yield improvement in Australian spring wheats

M.W. Perry

Western Australian Department of Agriculture Baron-Hay Court, South Perth W.A. 6151

Australian farmers have invested heavily in plant breeding. Whether explicitly stated or not, the breeder's aim is to identify genotypes which more efficiently explore the resources of an environment. How successful have we been, and what do past changes tell us of the future?

Methods

Twenty-eight Australian wheat cultivars representing a series from the 1860s to 1982 were grown in 20 field trials over four years in the wheatbelt of Western Australia. Cultural conditions were those used for experimental trials and commercial crops in the region. The cultivars included Introductions and selections made before 1900 plus cultivars released up to 1982. Five of the latter group were from crosses including semi-dwarf genotypes. Grain yields were measured on all trials and six trials were sampled for biomass and yield components.

Results and discussion

Based on regression of mean cultivar yield (20 trials) on years elapsed since 1884, yield increased from 1,022 kg/ha in 1884 to 1,588 kg/ha in 1982. This represents an apparent increase in grain yield due to genetic improvement of 566 kg/ha or 5.8 kg/ha/year. This is greater than the estimates for wheat in eastern Australia (1,2), but much lower than the 48 kg/ha/year found in the United Kingdom (3).

Regression of cultivar yield on site mean yield gave values of 'b' the slope of the regression, from 0.66 for old cultivars to 1.24 for some modern cultivars. This increased 'responsiveness' to improved cultural conditions is an important characteristic of modern cultivars.

In the six trials sampled for yield components,above-ground biomass was lower ($p < 0.05$) for early selections and their derivatives (pre-1960) compared to later cultivars (Table 1). Compared with modern tall cultivars, those with semi-dwarf parentage had equal biomass, but greater yield, harvest index (HI), ear number per m^2 and grain number per ear.

Table 1. Yield components for cultivars grouped as old (pre-Gabo) modern tall, and semi-dwarf

	Biomass	Yield	HI	Grain wt	Ear no.	Grains
	g/m^2			mg	$/m^2$	/ear
Old	542	156	0.29	29.8	215	24.5
Modern	574	197	0.34	28.9	241	28.4
Semi-Dwarf	564	203	0.36	25.4	247	32.5

The apparent plateau in total biomass and the importance of increased grain number (compared to stable or decreasing grain weight) will be issues of importance to breeders and physiologists in the future.

1. Russell, J.S. (1973). J. Aust. Inst. Agric Sci. 39, 156-66.

2. O'Brien, L. (1982). J. Aust. Inst. Agric. Sci. 48, 163-68.

3. Austin, R. B. et al. (1980). J. Agric. Sci., Camb. 94, 675-89.