

Phosphorus efficiency in wheat cultivars

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An understanding of phosphorus "efficiency" of wheat cultivars is becoming increasingly necessary as the costs of production of phosphatic fertilizers increase. New cultivars which produce yields equivalent to today's cultivars, but at a lesser rate of phosphorus application, will allow more economic recovery of the applied phosphorus. Similarly, cultivars that retain proportionally more P in the stubble will lessen the amount of P exported from the crop system. Currently, 20,000 to 25,000 tonnes of P are exported annually from Australia in overseas wheat shipments. The determination of nutrient-"efficient" cultivars has, however, received scant attention.

Methods

From a preliminary glasshouse experiment in 1981-82, 9 wheat cultivars were selected for a field experiment in 1982-83. The lines selected represented cultivars currently grown in Australia and material from advanced breeding programmes at Narrabri and Tamworth. The experiment was conducted on a known P-deficient soil at "Girby", U.N.E. Rural Properties. The soil was a gleyed podzolic (coarse sandy loam) with a bicarbonate-available P (1) of 5 ppm. Phosphate fertilizer was applied at 4 rates equivalent to 2, 10, 40 and 80 kg P ha⁻¹. The experiment was a fully randomised block design with 4 replicates.

Results and Discussion

All cultivars responded to P application and produced near maximum yields at 10 kg P ha⁻¹ (P₂). At P₂, the cultivars Gite and Tamworth F78-1313, produced the highest yields. These two cultivars best fit the description of a nutrient-efficient plant, i.e. a plant which outyields other plants at low nutrient levels yet produces equivalent yields at high nutrient levels.

Table 1. Variety responses to applied phosphate.

	Grain Yield at P ₂ (t ha ⁻¹)	$\frac{\Delta Y}{\Delta P}(P_{10}-P_2)$ (kg grain response kg P applied ⁻¹)	P Harvest Index at P ₂ (%)
Olympic	0.18 e	116.4	46 c
Sunstar	0.50 de	105.6	68 b
Narrabri Sun 66M	0.68 cde	33.2	87 a
Narrabri Sun 56A	0.86 bcd	27.6	94 a
Israel M68	0.95 abcd	54.5	90 a
Condor	1.16 abc	57.9	89 a
Hartog	1.38 ab	19.5	94 a
Tamworth F78-1313	1.45 ab	37.6	95 a
Kite	1.61 a	51.3	96 a

Means within columns followed by the same letter are not significantly different at 5s Duncan's Multiple Range.

The cultivars Olympic and Sunstar, although showing large responses to applied P, yielded poorly at the low P level. Gite and Tamworth F78-1313, however, yielded well at low P and produced responses of 51.3 and 36.6 kg grain yield per kg P applied, respectively. P harvest indices (P grain/ P tops) decreased with P application. At P₂, P harvest index increased with increasing grain yield. If the P harvest index can be decreased whilst maintaining grain yield, less P will be removed from the system.

1. Colwell, J.D. 1963. Aust. J. Exp. Agric. Anim. Hus. 3:190-197.

