Genotypic variation in the response of barley cultivars to different levels of phosphorus fertility

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There is evidence that genotypic variation exists in barley in response to applied phosphorus (P). Thus, efficiency of phosphate use can be improved by traditional breeding Methods. An understanding of the mechanisms controlling P efficiency would enable appropriate parameters to be chosen for screening and thus facilitate a breeding program. In field work in 1987, D.J. Reuter and coworkers found that O'Connor produced maximum grain yield with lower P additions than did Galleon, Forrest or Schooner (personal communication). In the experiment reported here, we examined those four cultivars for possible differences in metabolic P requirement.

Methods

O'Connor, Forrest, Galleon and Schooner barley were grown in the glasshouse in pots containing 3 kg of steamed, Yalanbee gravel. Seven rates of P were applied before sowing (from 0 to 500 mg P kg^{-1} soil) and the soil was thoroughly mixed. Ten plants per pot were grown. Stage of growth at different dates was recorded. Nineteen days after sowing, 5 plants per pot were harvested and dry weight and P concentration of the second oldest leaf and the remaining shoot were measured. Grain yield was measured.

Results and discussion

These barley cultivars did not differ greatly in their shoot weight at the first harvest. However, there were significant interactionss between genotype and P application rates for P concentrations at the first harvest ($p<0.001$) and for grain yield ($p<0.05$). At lower levels of added P, Forrest and O'Connor had higher P concentrations than Galleon and Schooner. For any given shoot P concentration above 0.2%, O'Connor had higher grain yield than the other varieties tested here and could perhaps be called P-responsive as well as P-efficient. In contrast, Forrest had the lowest grain yield at any given internal P concentration.

The maturity of all cultivars was delayed by P deficiency, however the maturity of O'Connor was delayed the least. This effect on time to maturity could help explain O'Connor's P efficiency in the field. If O'Connor is quicker to mature than other varieties when P-deficient, then it may be less susceptible to other stresses in the field such as drought during grain-filling.

At the highest P addition, Galleon and Schooner had more P in their second oldest leaves before senescence than did Forrest and O'Connor. There may be genotypic variation in the ability to accumulate P and remobilize it from senescing leaves. Current experiments are testing these hypotheses.