

High Vigour Wheat for Australia

Highly vigorous wheat has the potential to benefit growers through better weed control and higher yields. Environmental benefits will include reduced herbicide use and larger root systems to reduce deep drainage and capture water and nutrients more effectively.

CSIRO Plant Industry, through Graingene[®], is breeding high-vigour wheat cultivars with prospects for greater water use efficiency, better control and management of weeds and improved late sowing options.

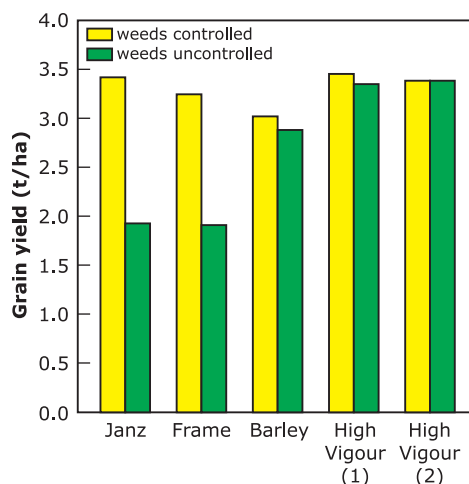
Already research conducted through CSIRO and the University of Adelaide has identified the importance of greater early vigour for improving grain yields where weeds are difficult to manage.

Chemical and mechanical control of weeds currently costs Australian farmers \$80 per hectare. Even where weeds are controlled, herbicide resistance and late weed emergence can result in a vast seed bank in following crops.

Wheats that develop leaf area quickly early in the season compete well against weeds, sometimes completely suppressing them without the need for chemical or mechanical control.

A three-year study by CSIRO and the University of Adelaide has evaluated the competitiveness of over 200 wheat varieties from Australia and overseas.

Wheats were evaluated for early vigour and the ability to tolerate or suppress weed growth. Wheat lines were identified as weed-tolerant if they produced high yields in the presence of weeds while a number of breeding lines were also found to suppress weed growth.



Average yields, over two years, of commercial and high-vigour lines, with and without weed control. Barley is included for comparison.



New vigorous wheat varieties can suppress weeds without chemical or mechanical management.

By measuring aspects of wheat and weed growth, researchers found plants that produced greater leaf area faster intercepted more sunlight to shade out weeds. If greater leaf area could be achieved from seedling emergence, then the wheat crop slowed weed growth and maintained more vigorous growth throughout the season.

The study found that current Australian wheat varieties performed poorly in terms of competitiveness. Vigour has been largely bred out of wheat over the last 100 years as breeders focused on better grain quality and disease resistance.

Investigations of overseas wheat varieties identified several genes that could be used to breed for greater vigour. These genes increase the size of the embryo, reduce leaf thickness and promote earlier tillering. Graingene[®] is identifying chromosomal regions containing these genes to assist in selection of the most vigorous breeding lines.

Preliminary research also shows that greater early vigour is associated with increased root growth, which can starve weeds of nutrients and water.

Even where weeds are not a problem, a larger root system can intercept water and nutrients that would otherwise be leached beyond the roots. Leaching of nitrogen is a major problem in some countries and on sandier soils in parts of Australia.

Greater leaf area is also important in reducing soil evaporation, especially in Mediterranean environments. Barley, triticale and oats have greater early vigour than wheat. Studies comparing these cereals with wheat have shown that early shading of the soil surface retains more moisture for use by the plant, boosting water-use efficiencies and grain yields.

Current CSIRO research is aimed at understanding genetic control of early vigour and, with Graingene[®], is developing breeding strategies to improve the efficiency of selection. For example, gene technology is being used to target desired genes and speed up breeding. The use of molecular markers can hasten the process of conventional breeding and the release of a commercial variety by two to three years.

Research is supported by funding from the Grains Research and Development Corporation. Graingene[®] is a joint venture between CSIRO, GRDC, AWB[®] and Syngenta[®].



Commercial lines (left) and high-vigour wheat.

High vigour wheats perform particularly well in hard soils commonly associated with direct-drilling, while more rapid leaf area development shows promise for crops sown late due to delayed sowing rains.

High vigour germplasm containing the new genes have up to three times greater leaf area early in the season than current varieties. The most vigorous of these wheats are now being used as parents in a breeding program to select disease-resistant, milling quality wheats with greater vigour.



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