# Evolutionary wheat makes the grade

*EFRC's strategy of 'evolutionary, or population, breeding' challenges current pedigree line breeding approaches.*

*Composite Cross Populations (CCPs) are the collective progeny of multiple crosses of pure line cultivars. Such populations can be adaptable to different and changing environments over seasons.*

*For this project, three CCPs were produced from:*

1.) *parent varieties selected for good milling potential- Quality (Q) CCP;*
2.) *parent varieties selected for high yield (Y) potential- YCCP; and*
3.) *both sets of parent varieties - YQCCP.*

*The three CCPs are further divided into those without or with plants with heritable male sterility (ms), which facilitates cross-fertilisation amongst plants.*

**Evolution of winter wheat is continuing at Elm Farm Research Centre at four sites (two organic and two non-organic) in the East and West of England. Results from last season's trials (2004-05) give an insight into the potential of novel breeding methods and diverse populations in sustainable systems. Data from 2004's harvest were reported in *Bulletin 76.***

Establishment of CCPs and mixtures (relative to the parent cultivars) was greater in the organic systems than in the non-organic systems, which may suggest that the CCPs were better able to deal with the greater environmental variability at the organic sites. For establishment in non-organic systems, the yield and yield-quality CCPs had a significantly higher establishment than their equivalent physical mixtures.

Grain yields were considerably higher in the trials of 2005 than in trials of 2004 (7.9 and 5.1 t/ha @ 15% mc respectively, $p < 0.001$), a trend that was reflected across the country (Source:HGCA). However, the effect was much larger, relatively, in the organic systems than in the non-organic systems (Table 1).

**Table 1.** Grain yields (t/ha @ 15% mc) for organic and non-organic systems in 2004/05 and 2003/04, and % change across years.

| Mean grain yield (t/ha @15%mc) | | | |
|---|---|---|---|
| System | 2003/04 | 2004/05 | % change across years |
| Non-organic | 7.9 | 10.0 | 127 |
| Organic | 2.6 | 6.0 | 228 |

In both organic and non-organic systems, CCPs tended to produce a greater grain yield than the means of their parent cultivars. This was more strongly evident at the organic sites – an early indication of the yield potential of the CCPs for organic management?

In both organic and non-organic systems the grain yield of the yield CCPs was significantly higher than that of the quality (e.g. Table 2).

Comparing organic and non-organic sites, there was a clear difference in relative performance of the modern varieties, in the sense that they produced high yields under non-organic conditions but relatively poor yields under organic conditions.

Importantly, the CCPs exhibited a greater stability of yield across organic sites compared with their parents and, encouragingly, to their physical mixtures. However, this effect was not evident under non-organic conditions.

**Table 2.** Mean yield, HI, Protein concentration and Hagberg Falling Number of CCPs at organic trial sites, 2004/05 (l.s.d. = least significant difference- any differences greater than this are significant).

| | Organic CCP | | | |
|---|---|---|---|---|
| | Y | Q | YQ | l.s.d. |
| Yield (t/ha @15% mc) | 6.1 | 5.6 | 6.3 | 0.46 |
| HI (Harvest Index) | 0.52 | 0.48 | 0.51 | 0.025 |
| Protein (%) | 11.4 | 12.1 | 11.5 | 1.21 |
| Hagberg Falling Number (s) | 159 | 189 | 183 | 20 |

In both organic and non-organic systems, the harvest indices of yield CCPs (YCCPs) were greatest, followed by YQ and Q CCPs. (Table2).

Quality data (HFN and % protein) were as expected (QCCP > YCCP), with no compromise in quality from composite cross populations. The same trends were also evident for thousand grain weights (TGW) at organic and non-organic sites.

Seed borne diseases were generally at low levels. There were significant differences between systems, with lower Microdochium nivale levels on organic sites and lower ergot levels on non-organic sites.

This selected sample of the large volume of data for the trial season 2004/5 suggests that the composite cross populations are continuing to evolve under natural selection. Two more years of trials will investigate this possible trend.

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