A participatory approach to variety trials for organic systems

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***Abstract* – A participatory research methodology was used to compare the performance of UK wheat varieties under organic conditions. Plots of three breadmaking winter wheat varieties (Hereward, Solstice and Xi19) and a mixture (1:1:1) of the varieties were grown at 19 UK farms in two seasons (2003/04 and 2004/05). Measurements were taken of growth habit, yield and grain quality. Grain yields in both seasons showed significant site by variety interactions, although the variation among sites was greater than among varieties in both instances. Wheat grown at Western sites was significantly shorter and higher-yielding than that grown at Eastern sites in 2003/04 but significantly taller in 2004/05. As with grain yield, greater variation among site than variety was found in the Hagberg Falling Number and protein concentration results in both seasons. The results from the two years of trials illustrate the variability of organic systems and the difficulty in selecting a single variety suitable for organic farms.[1]**

Introduction

The current source of comparative information about cereal varieties for UK farmers is the Recommended Lists of cereals (Anon., 2006). These lists are of limited value to organic farmers. Firstly, the data relates to crops grown under conventional management and although 'untreated yields' are available, these only refer to fungicides, with all other inputs being applied according to best management practice. Secondly, information about characters important in organic production such as weed suppressive ability and resistance to seed borne diseases is not included. Finally, no information is supplied about varietal mixtures, the use of which may be advantageous in organic systems by buffering the spread of diseases, and reducing the number of insect pests and weeds present in a crop (Wolfe, 2001).

A number of organic variety trials have been carried out in the UK. For example, NIAB carried out trials in 2000, and the results were published in the 2001 Cereals Variety Handbook (Anon., 2000). However, these trials were restricted to just three sites. There has also been little information available detailing the occurrence of seed borne diseases in organic cereal seed.

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To address these deficiencies, and to do so rapidly, a new approach was required to determine varietal performance in UK organic agricultural systems. Participatory research and development approaches are now recognised as an important part of developing sustainable agricultural production systems (Keating, 2000), that address the needs of the farming industry and end users.

This paper presents varietal performance and seed borne disease results from organic winter wheat experiments performed using a participatory research methodology. For a discussion of farmers' and researchers' opinions on the participatory methods used see Jones et al. (2006, these proceedings).

Materials and Methods

Seed (25 kg) of the UK breadmaking winter wheat varieties Hereward, Solstice, Xi19 and a mixture (1:1:1) of the three varieties was distributed to 19 UK farmers in September 2003 and 2004. Farms were scattered between the east and west of England; most farmers participated in both years, however not all sites were the same. Participating farmers sowed the seed in large marked plots using their standard methodology within a field containing wheat.

Researchers gained information from each of the farmers about their farming system (e.g. number of years organic, farming enterprises), the trial field (e.g. soil type, previous cropping) and the trial (e.g. drilling date, row width).

Prior to harvest, but when the crop was ripe (Growth stage 92 (Zadoks et al., 1974)), each farm was visited and measurements taken from four places within each variety plot. At each location weed incidence, crop height and ear numbers were measured and ears taken from 1 m^2. These were subsequently threshed, grain yield, thousand grain weight (TGW) and specific weight was measured and samples taken for protein and Hagberg Falling Number (HFN) determination.

Samples of grain for each variety at each site were sent to NIAB, Cambridge, for seed borne disease testing. Grain from other producers and seed merchants were also tested.

Results and Discussion

Grain yields

The overall average yield in 2004/05 (5.60 t ha^{-1}) was higher than in 2003/04 (3.9 t ha^{-1}) (Figure 1).

Yield results in both 2003/04 and 2004/05 showed significant ($P < 0.05$) site by variety interactions. However, yield variation among sites was much larger than the difference between varieties in both seasons. This variability in yield was a result of both system and site level interactions.

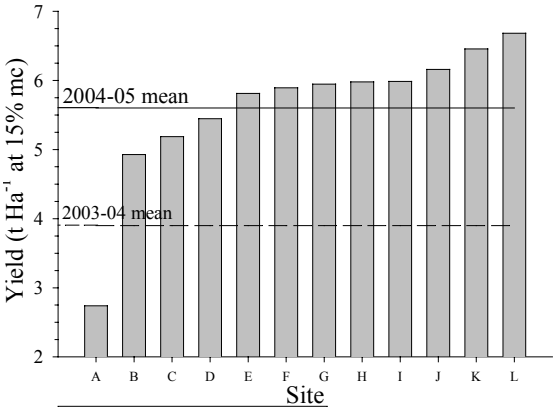

Figure 1. Average 2004/05 yields of the three varieties and mixture at each site (LSD = 0.66) and the means of all yield data in 2004/05 and 2003/04.

Growth habit

The results from 2003/04 revealed an East-West split across the country; the wheat in the west was shorter but higher yielding compared to the taller and lower yielding wheat in the East. In contrast, in 2004/05 the wheat grown on the western sites was significantly ($P < 0.001$) taller than those in the east (77.6 cm and 70.1 cm in the west and east, respectively), although the differences weren't as large as in 2003/04. The eastern sites also seemed to be lower yielding than the western sites, but this was due to the low yields at site A (Figure 1), which affected the overall average for the eastern sites.

Grain quality

Although there were no significant differences among the HFN results of the varieties in either year, on average HFNs were higher in 2004/05 than the previous season (Table 1). The low HFN results in 2003/04 can be attributed to the wet summer which caused grains to sprout and HFNs to drop.

Table 1. Grain quality results of varieties and the mixture in 2003/04 and 2004/05.

	HFN (s)	Protein (%)	TGW (g)	Specific weight (kg/Hl)
2003/04				
Hereward	245	11.8	50.3	72.9
Solstice	227	11.7	48.7	72.2
Xi 19	212	12.3	49.9	70.2
Mixture	222	12.0	50.4	72.3
Mean	**226**	**12.0**	**49.8**	**71.9**
l.s.d.	11.4	0.56	2.53	0.72
2004/05				
Hereward	240	10.2	44.8	79.5
Solstice	256	9.5	45.1	79.7
Xi 19	279	9.5	47.3	76.3
Mixture	248	9.7	45.3	78.7
Mean	**256**	**9.7**	**45.6**	**78.5**
l.s.d.	49.2	1.54	0.22	0.92

Unlike the HFN results, the average percentage protein was lower in 2004/05 than 2003/04 (Table 1). However, if the protein harvested per hectare is calculated using the yield results, it can be seen that, in fact, the yield of protein per hectare increased by 16 % (0.06 t Ha^{-1}) between 2003/04 and 2004/05. However, the carbohydrate in the grain increased by a greater proportion (47 %). Therefore, it can be seen that the weather difference between years affected more the carbohydrate producing potential of the crop rather than the protein producing potential because the latter is much more dependent on available soil-bound nitrogen.

Most of the varieties in 2004/05 achieved the milling requirement for HFN (>250s) and all made the requirement for specific weight (>76 kg/Hl); an improvement on the previous season where neither of these requirements were met by any of the varieties. However, none of the varieties met the protein level required for a milling premium (>13%) in either season.

Seed borne diseases

There was no evidence that seed borne diseases occurred at higher levels in organic production, and the health status of all seed was generally good across all sites and varieties

Conclusions

The two years of trials have shown the large variability of organic systems and that it is difficult to select a single variety suitable for organic farms. It can also be seen that although it is possible to meet most quality requirements for milling, achieving protein quality is very difficult.

Acknowledgement

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References

Anon., (2000). "2001 Cereals Variety Handbook", (NIAB: Cambridge, UK).

Anon., (2006). "HGCA Recommended List 2006/07 for cereals and oilseeds", (HGCA: London, UK).

Biggs, S. (1989). "Resource poor farmer participation in research. A synthesis of experiences from nine national agricultural research systems", (ISNAR: The Hague, the Netherlands).

Keating, R. (2000). "Review of Current European Research on Organic Farming", (ADAS: Wolverhampton, UK).

Wolfe, M.S. (2001). In "Organic Cereals and Pulses", pp. 29-49, eds D Younie, B.R. Taylor, J.P.Welch and J.M. Wilkinson. (Chalcombe Publications: Lincoln, UK).

Zadoks, J.C., Chang, T.T. and Konzak, C.E. (1974). *Weed Research, Oxford* **14**: 415-421.