



THE BREADMAKING QUALITY OF CANADA WESTERN SPRING WHEAT IN ORGANIC CROPPING SYSTEMS

Final Research Report W2007-28

INTRODUCTION

Varieties of the Canada Western Red Spring (CWRS) wheat class are ideal for breadmaking due to their high protein content and superior milling and baking qualities. The quality of CWRS grain is most commonly measured by protein content and test weight, although falling number, particle size index, flour yield, sodium dodecyl sulphate sedimentation (SDSS) and several others are also used.

Breadmaking quality may be affected by variety and growing environment. Factors such as soil nitrogen (N), moisture, and heat stress are thought to affect grain protein and test weight (Randall et al. 1990; Peterson et al. 1998). Organic farmers do not use inorganic fertilizer and may rely more on tillage for weed control. These management practices have the potential to create a higher-stress growing environment and reduce commercial breadmaking quality. Any varietal differences in quality may be more apparent under higher stress conditions.

Research trials were conducted at the University of Alberta to establish if high quality wheat can be grown on organically managed land and to determine whether any CWRS cultivars exhibit superior breadmaking qualities under organic management.

Table 1. Glossary of Quality Terms

| Parameter | Importance |
|-------------------|--|
| SDS Sedimentation | Indicates gluten strength |
| Falling Number | Indicates sprouting damage |
| Mixing Dev't Time | Time required for dough to reach full (peak) development |
| Energy to Peak | Energy required for dough to reach full development |
| Peak Bandwidth | Energy in the envelope of the band at full development |

WHAT WAS DONE?

Five CWRS varieties (Red Fife, Marquis, Thatcher, Park and McKenzie) were grown at one conventionally managed and one organically managed site in each of 2003 and 2004 in Edmonton, AB. Conventionally managed sites received applications of mineral fertilizer at planting and chemical broadleaf herbicide prior to heading. Organically managed sites were managed according to Organic Crop Improvement Association International certification standards. Organic sites received annual applications of composted dairy manure at approximately 50% dry matter and 1.3% total nitrogen.



(H. Mason)

Plots were seeded in mid-late May and were harvested at maturity in early-mid September. Grain yield and test weight were determined, and grain samples were sent to the Agriculture and Agri-Food Canada's Cereal Research Centre to be analyzed for their breadmaking quality. Measures of quality included wholemeal protein, flour yield, falling number, particle size index, SDS sedimentation, and the mixograph parameters (measures of dough strength) of mixing development time, energy to peak and peak bandwidth (Table 1).

WHAT HAPPENED?

On organic land, grain yield, test weight and SDS sedimentation (SDSS) were lower, while peak bandwidth (PBW) was slightly higher on organic land (Table 2). Test weights were high enough in both systems to garner a No.1 CWRS grading (>75 kg hL⁻¹).

Table 2. Mean grain yield and quality indicators of CWRS wheat grown at conventionally and organically managed sites in Edmonton, AB

| | Yield (t ha ⁻¹) | Test weight (kg hL ⁻¹) | Grain protein (%) | SDSS (mL) | MDT (min.) | PBW (% torque min. ⁻¹) |
|--------------|--------------------------------|---------------------------------------|----------------------|--------------|---------------|---------------------------------------|
| Conventional | 3.7 | 78 | 14.9 | 43.1 | 2.2 | 17.6 |
| Organic | 3.2 | 77 | 14.7 | 40.8 | 2.2 | 19.0 |
| F test mgmt | * | * | <i>ns</i> | ** | <i>ns</i> | ** |

ns, *, ** denotes non-significance, significance at $P < 0.05$ and $P < 0.01$, respectively

Grain protein and mixing development time (MDT) did not differ between the two management systems (Table 2), suggesting that high quality organic CWRS production is possible.

Almost half the variation in peak bandwidth, test weight and grain protein was due to environment/management factors, while variety had a large influence on kernel hardness and flour yield (Table 3). This suggests that differences in management can influence breadmaking quality.

Varieties performed differently in the two management systems, with some performing somewhat better under organic and vice versa. Because the differences were inconsistent across all measures of quality, it is difficult to identify varieties suited specifically for organic production. Overall, Park (released 1963) and McKenzie (released 1997) performed the best, while Red Fife (released 1885) was among the poorest performing varieties. This indicates that older varieties may not be as suitable as some modern cultivars for high quality bread wheat production, regardless of management system.

Table 3. Percent variation in agronomic and quality measures attributable to variety and environment

| Variety | Environment |
|-------------------------------|----------------------|
| Kernel hardness (70%) | Peak bandwidth (51%) |
| Flour yield (40%) | Test weight (49%) |
| Energy to peak (28%) | Grain protein (48%) |
| Mixing development time (26%) | Grain yield (37%) |

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THE BOTTOM LINE...

Grain yield, test weight and protein content appear to be most influenced by environmental factors, including management system. CWRS varieties perform differently under organic and conventional management, although it is difficult to identify varieties better suited to one system.

Older CWRS cultivars, such as Red Fife, are not necessarily better suited to organic bread wheat production. While differences exist in the breadmaking quality of conventionally and organically grown wheat, high quality CWRS wheat production on organically managed land is possible.

REFERENCES

- Randall, P.J., Freney, J.R., Smith, C.J., Moss, H.J., Wrigley, C.W. and Galbally, I.E. 1990. Effect of additions of nitrogen and sulfur to irrigated wheat at heading on grain yield, composition and milling and baking quality. *Australian Journal of Experimental Agriculture* 30:95-101.
- Peterson, C.J., Graybosch R.A., Shelton, D.R. and Baenziger, P.S. 1998. Baking quality of hard winter wheat: Response of cultivars to environment in the Great Plains. *Euphytica* 100:157-162.

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