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MARITIME ORGANIC SPRING WHEAT CULTIVAR TRIAL (2007-2008)

Interim Research Report – E2009-54

INTRODUCTION

Achieving high grain yield and protein content can be a challenge for both organic and conventional producers of spring milling wheat in the Maritimes. A spring wheat cultivar specifically bred for organic agriculture has not yet been developed in Canada. Cultivar recommendations specific to organic production are also not available for the Maritime Provinces. At this time, organic producers select cultivars according to processor preferences. Additionally, wheat cultivars respond differently to the conditions present at different sites. Thus, across Canada, cultivar selection is a regional decision with recommendations often made by provincial governments. This is necessitated by Canada's wide geographic area and many different climate zones.

Some cultivars are known to yield similarly across a wide range of environments. Because of the variability, both within and between organic farms, these yield stable cultivars have been recommended for organic cereals production (Mason et al, 2008). They found that yield stable cultivars performed well under areas of high weed pressure and low fertility. This study investigated the production potential of different spring wheat cultivars under organic management conditions in the Maritime Provinces, and evaluated the yield stability of these cultivars.

WHAT WAS DONE

The experiment was conducted over two years (2007 and 2008) at three locations per year, one each in Nova Scotia (NS), New Brunswick (NB) and Prince Edward Island (PEI). The same location was used both years in PEI and NS; however, in NB a different specific site was used in each year. This provided a total of six site-years or environments.

AC Walton and AC Barrie, (two cultivars preferred by a local organic flour mill), AC Helena (a common cultivar used in conventional systems in the Maritimes), and Red Fife (a highly valued heritage wheat cultivar) were grown on each site in 2007. In 2008, the cultivar Acadia (an old cultivar with very limited seed availability that may not be commercially produced), was added to the trial. As well, in 2008 two batches of Red Fife were used: one from a prairie source and the other from a NB source. Due to the variable and long history of Red Fife in Canada, the two seed batches were treated as different cultivars. Thus in 2008 "New Brunswick Red Fife" and "Prairie Red Fife" were grown along with Acadia and the other cultivars grown in 2007. Unfortunately, the seed for Prairie Red Fife was not available in time for planting at the NS site in 2008.

An environmental index was calculated by taking the average yield of all the cultivars in each environment and subtracting the overall average yield of all the cultivars in all the locations. This provided the relative yield potential of each environment. A regression analysis of the yield of each cultivar against the environmental index is used as a measure of the stability of the cultivar.

Seeding in 2008 with the summer field crew (From L-R: E. Papineau, M. Bernard, L. Rector, A. Hammermeister (photo cr.), L. Poon, D. Kerr)

WHAT HAPPENED

In 2007, yield was highest at the NB site, with the PEI site showing the lowest yields. Overall in 2008, yield on all the sites was relatively low, with the highest yield coming from the PEI site (Figure 1). High rainfall early in the 2008 season resulted in increased weed pressure on all sites, with the PEI site having the lowest amount of weed competition

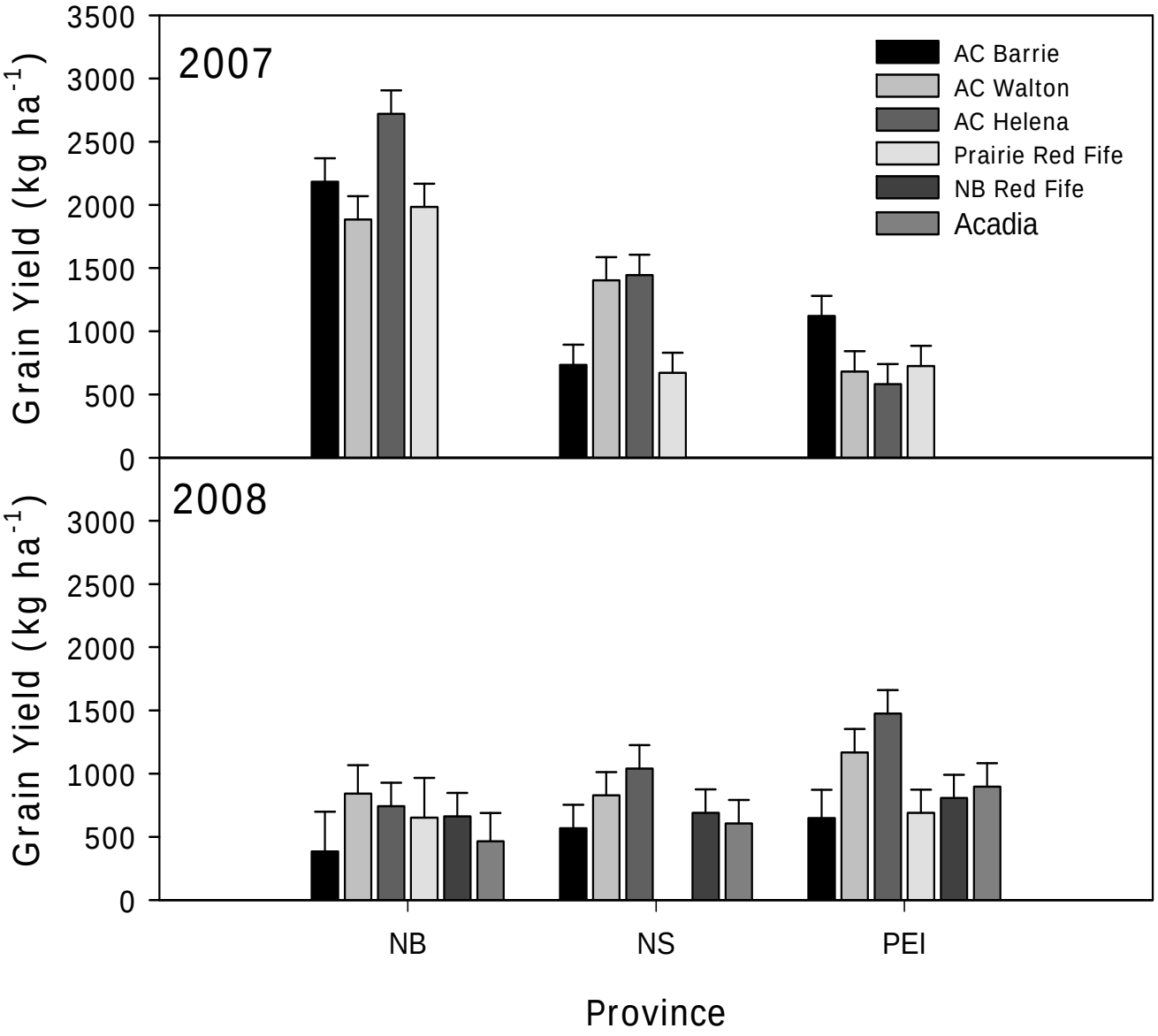

Figure 1: Grain yield recorded from a total of six cultivars grown in cultivar trials conducted on three organically managed sites each year in the Maritime Provinces in 2007 and 2008.

(data not shown). Evidence of cultivar differences were observed in each year, with AC Helena and AC Walton yielding the highest in all three sites, and AC Barrie with the lowest yield, with the exception of PEI in 2007. There was also evidence of cultivar by site interaction.

The interaction means the different cultivars responded differently depending on the site. Thus, in the Maritimes, cultivar selection could be considered even more regionalized than the prairies. This may be due to the widely varying soil types, elevations, and marine influences between the three provinces. Data has not been collected for the province of Newfoundland and Labrador. The average yield potential of each environment (site by year) was similar for all environments except for the New Brunswick location in 2007 ($P < 0.01$). The conditions present were arguably ideal for growing wheat organically in the Maritimes.

As a result, the site was dropped from the stability analysis to enable an investigation of the influence of typical Maritime growing conditions on the different wheat cultivars. An index of environmental effect was created by subtracting the average yield across all the cultivars and environments from the average yield of all the cultivars within each

environment. The two Red Fife seed batches and AC Barrie were stable across environments while the remaining cultivars were responsive to favorable conditions (Figure 2). This also means that the responsive cultivars will yield below average if the conditions are not favorable.

Thus, stable AC Barrie was a good choice in the unfavorable field conditions in PEI in 2007, while responsive AC Helena was better able to capitalize on the ideal growing conditions in NB in 2007. It should also be noted that the two Red Fife seed lots did not yield differently ($P > 0.05$). Wheat is approximately 99% self-pollinated (Hucl, 1996). This makes wheat an inbred species and results in the near identical genetic makeup of individuals within a specific cultivar. Wheat breeders have to manually cross wheat parents by removing the male flower parts before the pollen is released. Pollen is then introduced from the donor cultivar to complete the cross. The breeders make selections on the resulting offspring, after many generations of self-pollination. This allows for the genetic makeup of the different sister lines to become consistent between generations. This pure line breeding is common in self pollinated crops, and once such a cultivar is released, the genetic make-up does not change regardless of where the seed is propagated.

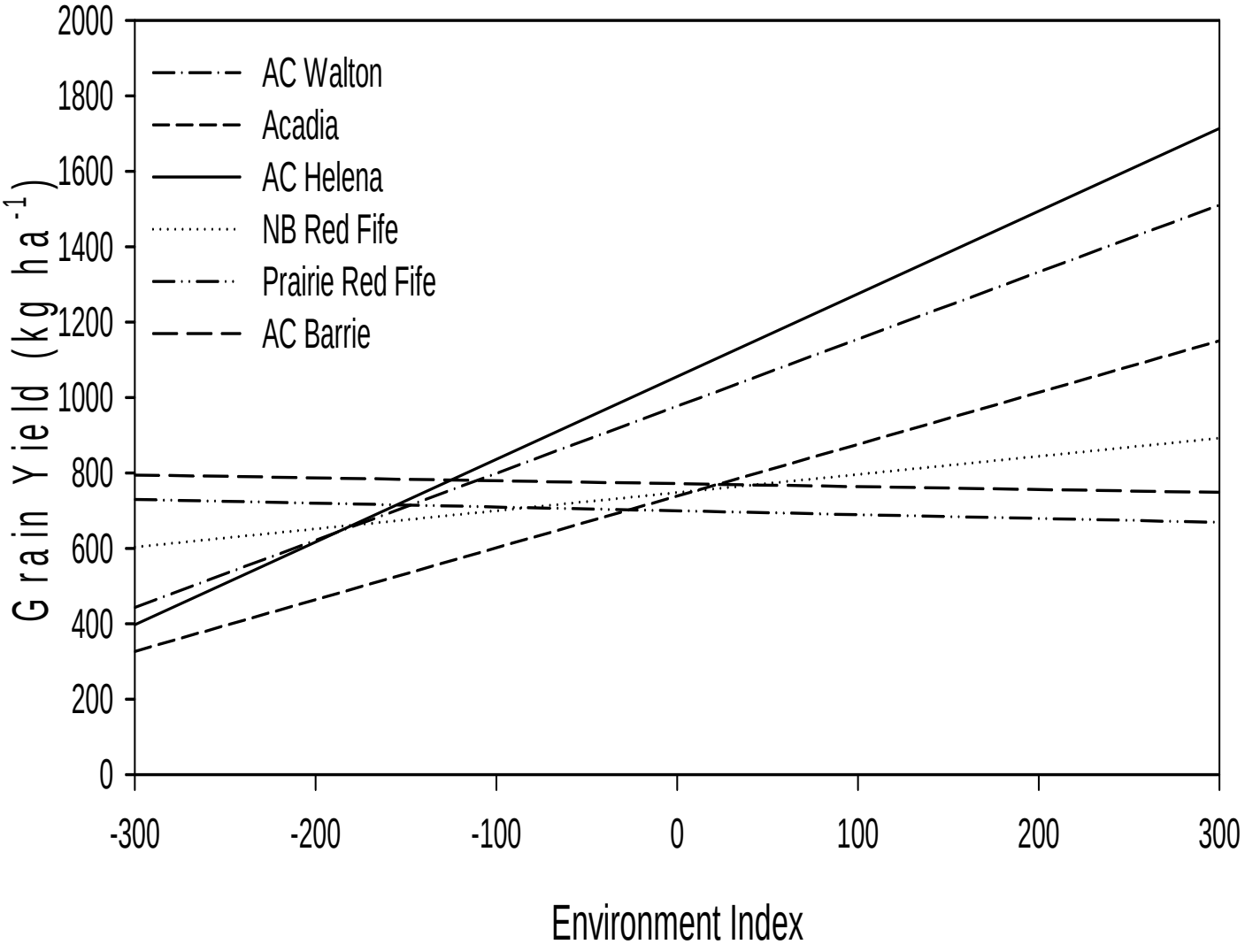

Figure 2: Estimates of yield stability for six spring wheat cultivars grown in five environments, each with similar growing conditions and yield potential.

BOTTOM LINE

Cultivar selection is ultimately the choice of the farmer. The results of this study may assist in the decision making process, but they should not be considered to be specific cultivar recommendations. Stable cultivars allow for a more predictable end result. A less yield stable cultivar could be considered a gamble but may provide a greater yield advantage in a better than average year. Nevertheless, our findings show that producing high quality milling wheat under organic agriculture is achievable in the Maritimes. This study was limited to cultivars of special interest to local processors. Many other wheat cultivars are available and may be tested if growers and processors express a need.

Dr. Andrew Hammermeister explaining cultivar differences. (cr L. Poon)

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CREDITS

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