Yield stability in winter wheat composite cross populations under organic and conventional conditions from the F_5 to the F_{13}.

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Introduction

The use of Composite Cross Populations (CCPs) as an alternative breeding approach, has gained significant interest, particularly due to the potential adaptability of evolving populations to specific locations. Three winter wheat (*Triticum aestivum* L.) CC populations were created in 2001 through collaboration between Elm Farm Research Centre (ORC) and the John Innes Institute in the UK. The populations were created through the inter-crossing of 20 parental varieties, in order to create a high yielding (Y) population; a high baking quality (Q) population and a population consisting of the 9 x 12 (YQ) intercrosses. Since 2005/6 (F_5), the populations have been maintained at Kassel University without conscious selection.

The objectives of the study are to increase the resilience, adaptability and performance of winter wheat through increased genetic diversity, as well as the improvement of breeding efficiency and the introduction of a novel breeding method that has the potential to provide an alternative source of germplasm in the form of CCPs. The adaptation of CCPs into mainstream practice is hampered by a number of factors including legal and quality aspects, but yield performance and stability of the CCPs are important criteria in view of increasing climatic unpredictability and for farmers (Finckh *et al*. 2000). Actual yields, as well as the yield stability of the populations relative to a common reference variety will be presented.

Materials and Methods

The CCPs have been grown under both organic and conventional conditions since the F_5 at the research fields of the University of Kassel in Neu Eichenberg, Germany (51°22”N, 9°54”E, 247m ASL, mean annual ppt:619mm, mean temp.: 7.9°C). The variety Capo was also grown alongside the CCPs under both organic and conventional conditions for comparison. The populations under both organic and conventional management have been maintained since 2005 in plot sizes >100m^2 and information regarding yield and its components have been recorded. The mean location yields per year, under organic and conventional management, were compared to the actual yields of the populations. Simple regression analysis (as described by Finckh *et al*., 2000) was used to calculate the slope and fit of the model for the three populations (YQ, Q, Y) and of the reference variety Capo.

Results and Discussion

The mean combined yields of the organic and conventional populations over all years ranged from 4.54 t/ha for the Q population to 4.92 t/ha for the YQ population. The reference variety Capo had the highest mean combined yield of 5.60 t/ha. The regression of yields against the site mean show that the yields of YQ and Q CCPs increased proportional to the site potential (slopes close to 1.0 in Fig. 1). Yields of the Y CCPs increased more with site mean (1.06) indicating greater responsiveness to better growing conditions, while the slope of 0.86 of the reference variety Capo indicates that this variety performs relatively better at a lower yield potential. The high R^2 and low MSE (mean square error) values of the CCPs combined with

slopes around 1 or greater indicate a better yield stability than for Capo where the slope was considerably lower.

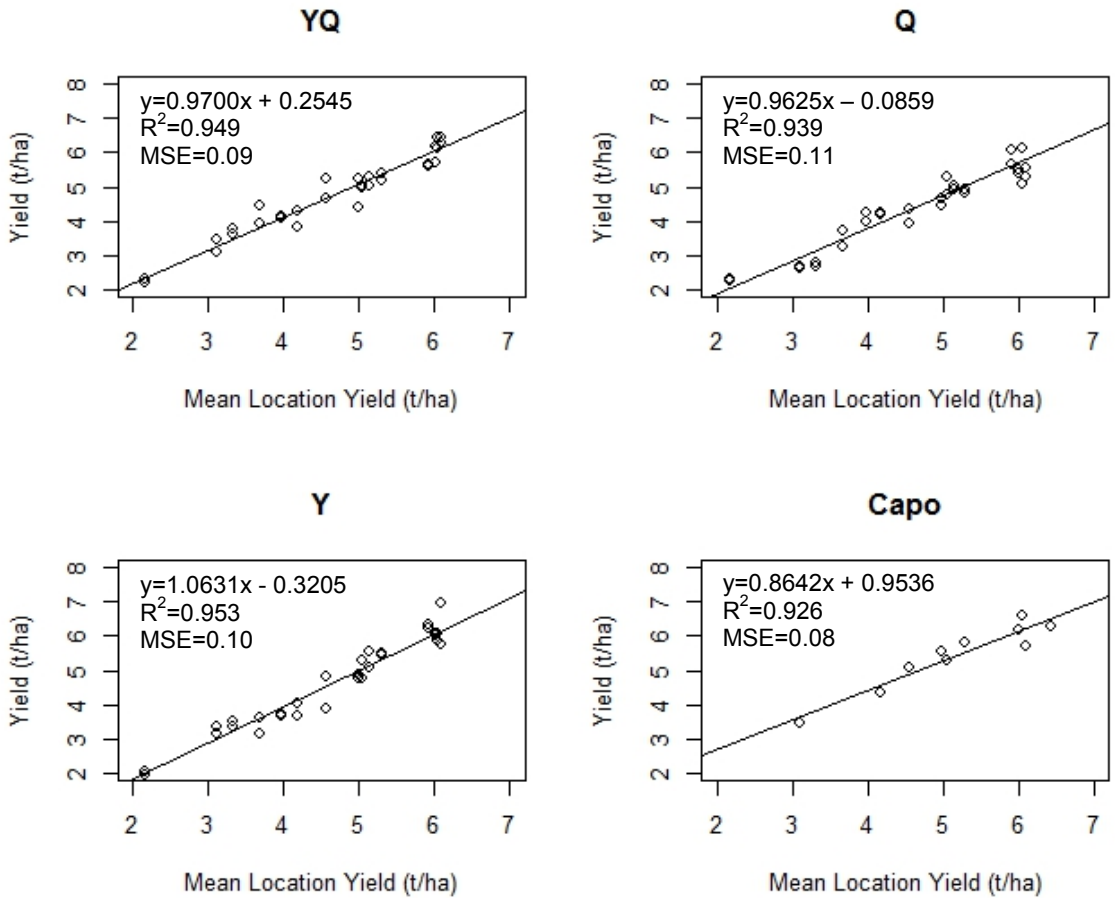

Figure 1: Effect of the overall yield potential of a site on the relative performance of wheat CCPs YQ, Y, Q, and the reference variety Capo over nine years (2006-2014). The actual yield of the CCPs and reference variety as compared to the annual mean location yield is plotted. The linear equation, adjusted R^2 and mean square error of the residuals (MSE) are shown.

Further analyses will be necessary to determine management system effects on yield stability of the CCPs, but also additional varieties over time. Additional data from 2015 will be included in the presentation.

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References

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