The effect of changing environmental conditions on composite cross winter wheat populations over six years from the F_8 to the F_{14}.

WEEDON, Odette[1]; HAAK, Annette; BRUMLOP, Sarah; HEINRICH, Sven and FINCKH, Maria Renate

[1]University of Kassel, Nordbahnhofstr. 1a, Witzenhausen, D-37213. Email: odetteweedon@uni-kassel.de

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Introduction

A lack of appropriate crop varieties specifically bred for the higher biotic and abiotic stresses experienced in organic and low-input systems, has driven novel breeding approaches such as Composite Cross Populations (CCPs) and other genotype mixtures, thereby increasing both intra- and inter-varietal diversity. The creation of CCPs using carefully chosen parental varieties, coupled with the ability of the populations to adapt to local environments means that these populations are well suited for low-input and organic agricultural systems (Phillips and Wolfe, 2005). COBRA (Coordinating Organic plant BReeding Activities for Diversity) aims to "support and develop plant breeding and seed production in Europe by increasing the use of plant material with High genetic Diversity (Hi-D) through coordinating, linking and expanding existing breeding and research in cereals (wheat and barley) and grain legumes (pea and faba bean)".

Three winter wheat (*Triticum aestivum* L.) CCPs were created in 2001, through collaboration with the Elm Farm Research Centre and the John Innes Institute. In 2005, seed batches of the F_4 of these populations were equally divided and distributed to three additional partners (France, Hungary and the University of Kassel). In 2007, it was decided to submit one of the CCPs to changes in environments every year. A pattern was developed between eight partners whereby these "cycling" populations would be grown in a plot of >100m^2 and sent to the next cycling partner the following year. The original partners (UK, Hungary and Germany) have also maintained their original "non-cycling" populations for comparison.

The aim of the project is to compare populations that all originated from the same seed batch in 2005, but that have been exposed to vastly different climatic conditions, in one site (Germany) for their performance and diversity (phenotypic diversity, yield and disease occurrence). 2014/15 is the second year of the project whereby both saved seed from 2013 and harvested seed from 2014 were sown, in order to compare two generations in one growing season and to ensure that the differences between populations were not in fact due to differing seed size and quality.

Materials and Methods

In 2013, seed from each of the eight "cycling" and three "non-cycling" populations were planted at the University of Kassel. Three commonly-used reference varieties (Achat, Akteur and Capo) were also used in the experiment for comparison. In 2014, saved seed from the original experiment was resown with newly harvested seed from the same populations (see Table 1). In addition, six CCPs that had been grown by six farmers in Germany for either two or three years were included in the experiment, as well as seven reference varieties. In both

experimental years information regarding yield, disease incidence (foot and leaf) and phenotypic variation were recorded.

Table 1: CC populations, farmer populations and reference varieties sown in the second experimental year at the experimental farm Neu-Eichenberg, University of Kassel.

Populations (Code)*		References	Farmer Populations		Cycling
2013 Harvest	2014 Harvest (Uni Kassel)		Harvest 2013	Harvest 2014	
D13NCI**	D14NCI	Achat	Frankenhausen	Gut Fahrenbach	NL14
D13NCII**	D14NCII	Akteur	Maßhalderbuch	Sudershausen	
D13NC**	D14NC	Butaro	Niederbeisheim	Wartmannsroth	
HU13	HU13-D14	Capo			
DK13	DK13-D14	Naturastar			
TUM13	TUM13-D14	Scaro			
F13	F13-D14	Wiwa			
HU13NC**	HU13NC-D14				
UK13	UK13-D14				
CH13	CH13-D14				
D13	D13-D14				
NL13	NL13-D14				
UK13NC**	UK13NC-D14				

*Partner codes and institutes: CH = FIBL, Switzerland; D = Uni. Kassel, Germany; DK = Agrologica, Denmark; F = INRA, France; HU = Centre for Agricultural Research, Hungary; NL = Louis Bolk Institute, The Netherlands; TUM = Technical University München, Germany; UK = The Organic Research Centre, United Kingdom.
**NC = Non-cycling population

Results and Discussion

Results from the first experimental year indicate significant differences between the populations mainly in terms of morphological characteristics. Observations in the field during the growing period showed noticeable phenotypic differences between the populations in terms of plant height, ear length and colour and whether the ears were awned or awnless. These initial results indicate that these populations, although from the same origin, have evolved and maintained a high degree of diversity through the different climates and locations and over time. In addition, the yields of the populations were not significantly different from the reference varieties, indicating that the CC populations yield performance is comparable to commonly used reference varieties. The harvesting and phenotypic assessment of the populations and reference varieties in the 2014/2015 experimental year will be available by October 2015 and preliminary results will be included in the poster for the conference in November.

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References

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