**Adaptation and suitability of Composite Cross winter wheat populations and other genotypes to differing N input levels**

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Evolutionary breeding through the introduction of composite cross populations (CCPs) encourages intra-specific diversity and increases diversity in the agricultural landscape. Increased genetic diversity in crops may help to buffer both biotic and abiotic stresses and will play an increasingly important role as climatic conditions become more unpredictable (Østergaard *et al*, 2009). A number of CCPs and other genotypes were tested at the University of Kassel under differing N input levels in order to test past adaptation and suitability to differing fertilization levels. The CCPs have been managed in Neu-Eichenberg since 2005 under both organic and conventional conditions without conscious selection. Genetically diverse CCPs have the ability to be able to adapt to their environment, which may also include the management system, meaning that CCPs grown under conventional conditions may be better suited to growing conditions with higher N inputs, in comparison to CCPs, which have been organically-managed under low N levels.

The project INSUSFAR (INnovative approaches to optimize genetic diversity for SUStainable FARming systems of the future) is a collaboration between 6 German partners. The main aim of INSUSFAR is to contribute to the understanding of the optimum intra-specific diversity needed in CC winter wheat populations for sustainable farming systems, which will include minimum tillage, the use of living mulch crops and increased intra-specific diversity. A better understanding of the optimum diversity needed to achieve adaptation to differing agricultural systems will in turn contribute to future breeding methods and goals. Ten CCPs with differing management histories, 10 commercial varieties and 15 line selections from CCPs and other material were tested under two N input levels (0kg N and 100kg N/ha). A split-plot design with N-input level as the main plot factor was managed under organic conditions with plot sizes of 18m$^2$ (12 x 1.5m). Triticale (*Triticosecale x*) was the pre-crop. Hornmeal pellets were applied to the fertilizer replicates shortly before sowing (28 October 2015). The experiment was harrowed once in the new year (April 2016) in order to control weeds. Soil Nmin samples of each replicate block were taken at sowing, after winter and at flowering at two depths (0-30cm, 30-60cm). The experimental task tests whether previous adaptation in the CCPs has occurred under differing management conditions over a number of years, and whether some CCPs are subsequently now better suited to higher or lower N input levels. The commercial varieties and CCP line selections represent a wide range of different morphological types, which were chosen in order to test suitability and performance under specific input conditions.

Assessments included ground coverage of wheat and weeds at the end of winter (BBCH 30-31), final stand height, number of ear bearing tillers per m$^2$, harvest index, grain and straw yields, as well as TGW. In addition to these, leaf disease assessments were done three times during the season (May to end of June), as well as a foot disease assessment at the beginning of July.

The main foliar pathogen of the 2015/16 experimental year was yellow rust (*Puccinia striiformis*), which has been the dominant foliar pathogen since new virulent races initially appeared in 2011. Significantly higher values for Area under the Disease Progress Curve (AUDPC) were found in the HI treatment (767), in comparison to the LI treatment (663). AUDPC values were generally low for most of the commercial varieties with a mean AUDPC over both input levels of 497. The CC populations displayed similar values of AUDPC (432-622 over both treatments) to the reference varieties and between each other. The selected lines from CCPs had generally higher AUDPC values in comparison to the commercial varieties and CC populations, indicating moderate to high susceptibility. After heavy rainfall in June, lodging occurred mainly in the 100kg N/ha treatment replicates with significantly higher mean percentage of lodging in the CCPs (71%) than in the references (29%). The yields for 2016 were generally low, and the difference between the mean yield of the 0kg N/ha treatment (3,81t/ha) and the 100kg N/ha treatment (3,90t/ha) was statistically significant, albeit quite low. The mean yield of the grouped commercial varieties under 100kg N/ha (4,83t/ha) was significantly higher than the mean yield of the CCPs (4,21t/ha), this was not the case under the low N input condition (4,26 versus 4,06t/ha, respectively). The CCP lines yielded significantly less than the mean yield of the CCPs: 19% under low N and 25% under high N input levels. There was a significant interaction effect between the N input level and the experimental entries ($p<0,001$), which is explained by the differing yield reactions of the entries under the high N-input condition. All commercial varieties had positive reactions in yield under the higher N input, but the CCPs and CCP lines had variable reactions in terms of yield. Two CCPs, which had previously been managed under conventional conditions, had similar yields under both N input levels, but one of the organically-managed CCPs was significantly better yielding under the 100kg N/ha treatment. Further analysis of other agronomic and phenotypic characteristics partly explain the differing reactions of the entries in terms of yield under the higher N input, but further testing in the next experimental year is planned, particularly to track N status over the season between selected commercial varieties and CCPs.

## Literature

Østergård H, Finckh MR, Fontaine L, Goldringer I, Hoad S, Kristensen K, Lammerts van Bueren E, Mascher F, Munk L & Wolfe M (2009) Time for a shift in crop production: embracing complexity through diversity at all levels. Journal of the Science of Food and Agriculture 89: 1439-1445.