INNOVATIVE APPROACHES TO OPTIMIZE GENETIC DIVERSITY FOR SUSTAINABLE FARMING SYSTEMS OF THE FUTURE: QUANTIFYING ECOLOGICAL PERFORMANCE

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Introduction

Climate change is expected to have a significant impact on the variability of abiotic and biotic factors affecting yield stability in agro-ecosystems. Future farming systems will have to be highly self-regulatory in order to compensate for adverse site effects and lower fossil fuel, fertilizer and pesticide inputs (Østergård et al. 2009). Crop diversity is a key element of the change necessary in farming systems (Howden et al. 2007). In the INSUSFAR project (INovative approaches to optimize genetic diversity for SUStainable FARming systems of the future), diverse wheat (*Triticum aestivum* L.) populations of different origin and degrees of diversity will be tested regarding the influence of intra-crop genetic diversity on crop performance under variable and changing environments. Yield, biodiversity and quality parameters of different composite cross populations (Döring et al. 2015) will be determined in field experiments and on-farm trials. To this end, new criteria for the assessment of ecological sustainability will be developed. Based on these results, scenario modelling of their integration into on-farm operations will allow an assessment of the ecological sustainability of these wheat populations.

Materials and Methods

On-farm experiments will be conducted on at least 8 German farms with differing site conditions, input strategies and tillage systems, in addition to field trials on experimental farms across Germany. Within each of the experiments, a plot with large spatial heterogeneity will be cultivated with novel composite cross populations and, for comparison, a reference line variety or hybrids. Utilizing portable spectroscopy and GPS equipment, non-destructive measurements of yield development and soil sampling will conclude in a site-specific map of the varieties' responsiveness to site heterogeneity. Innovative indicators for handling inter- and intra-specific diversity will be developed. Ecological sustainability will be assessed with REPRO software, mapping the whole production process including all inputs and outputs.

Work Progress

At the time of writing, three preliminary experiments employing different experimental designs had been established on TUM experimental sites. All three designs aim to utilize spatial heterogeneity in order to measure reactivity to adverse site conditions of the tested populations in comparison with reference line varieties. Varying in different geostatistical approaches, all three designs follow the same design principle (Fig. 1). After calibration

of the measuring equipment and geo-spatial referencing, spectroscopy measurements will be visualized in a map. Results will indicate the relation between genetic heterogeneity and reactivity to adverse site conditions.

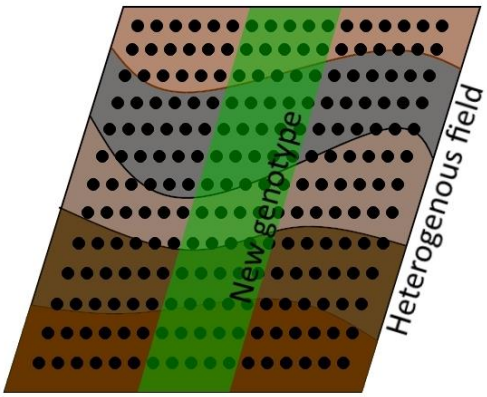

Figure 1. Schema of experimental design

Based on the preliminary results, one experimental design will then be selected and applied to on-farm experiments starting in September 2016.

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