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## Session 4 - posters

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### 23. Genotype x Environment Interactions of Winter Wheat

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Winter wheat cultivars for organic farming have to be adapted to highly variable environments. Yield and yield stability, the nutritional value and the bread making quality are here of major importance. Particularly, seed quality, tillering capacity, regeneration ability after harrowing, weed suppression ability, resistance or tolerance against diseases and improved nutrient use efficiency (NUE) under limited nutrient conditions need to be improved by specific breeding efforts (Kunz et al., 2006; Löschenberger et al., 2008).

Ten winter wheat cultivars were grown in 2007 in two organic systems of the DOK long-term experiment in CH-Therwil. Eight of these cultivars were tested in 2008 at three organic farms in different pedo-climatic environments in Switzerland to observe genotype x environment interactions under different organic conditions. In contrast to the DOK site on a fertile loess soil, the on-farm sites were located on sandy or sandy-loamy sites with lower inherent yield potential. We assessed grain yield, yield components and parameters related to baking quality and NUE.

Grain yield at the on-farm sites ranged between 2.2 t ha<sup>-1</sup> and 2.8 t ha<sup>-1</sup> and was much lower than at the DOK sites ( 3.7 t ha<sup>-1</sup> to 4.2 t ha<sup>-1</sup>) (Hildermann et al., 2009). Cultivars and sites significantly affected grain yield. Genotype x environment interactions were significant across the three on-farm sites; however they were not significant across all five organically managed sites. Calculated across the on-farm sites, there was a tendency towards higher yields of the organically bred cultivars. This effect was statistically significant at the lowest yielding site, where yield of the organically bred cultivars was 14% higher than yields of the conventionally bred cultivars. However, at the DOK sites and averaged across all five organic sites, the organically bred cultivars could not outperform the conventionally bred cultivars.

Similar to the grain yield, the total gluten content increased from the on-farm sites to the DOK sites. Irrespective of the site, the gluten index of the cultivars Scaro, Antonius and Caphorn was stable. In contrast, the gluten index of the cultivars Sandomir, CCP and Titlis highly varied between the tested environments. Yield was significantly correlated with grain N yield ( $r = 0.93$ ) and nitrogen (N) utilization efficiency (NUE) ( $r = 0.72$ ). Genotype x environment interactions were not significant for grain N yield, however strongly significant for NUE ( $p < 0.01$ ). The conventionally bred cultivars strongly responded to environmental conditions and showed a low NUE under at low N supply. In contrast, NUE of the organically bred cultivars Scaro and Sandomir was stable across all test environments.

Beside high yields, cultivars suitable for organic farming should achieve high baking quality and nutrient use efficiency under nutrient limited conditions. Among the tested cultivars, the organically bred cultivar Scaro revealed such a performance across all tested sites.

#### References :

- Hildermann I., Thommen A., Dubois D., Boller T., Wiemken A., Mäder P. (2009) Yield and baking quality of winter wheat cultivars in different farming systems of the DOK long-term trial, *J. Sci. Food Agri.* 89, 2477-2491.  
Kunz P., Becker K., Buchmann M., Cuendet C., Müller J., Müller U. (2006) Bio-Getreidezüchtung in der Schweiz, in: Österreichische Fachtagung für biologische Landwirtschaft Raumberg-Gumpenstein, Österreich, 21-22 March, 2006, pp. 31-35.  
Löschenberger F., Fleck A., Grausgruber H., Hetzendorfer H., Hof G., Lafferty J., Marn M., Neumayer A., Pfaffinger G., Birschtzky J. (2008) Breeding for organic agriculture: the example of winter wheat in Austria, *Euphytica* 163, 469-480.