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Topic 1 - Ecological approaches to systems' health

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ON-FARM TESTING OF EMMER AND EINKORN LANDRACES UNDER ORGANIC CONDITIONS IN HUNGARY

Judit Fehér* [1], Szilvia Bencze[1], Péter Kalló[1], Mihály Földi[1], Péter Mikó[2], Dóra Drexler[1]

[1]ÖMKi Research Institute of Organic Agriculture, Budapest, [2]ATK Agricultural Institute, Centre for Agricultural Research, Martonvásár, Hungary

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Abstract: Nowadays even organic agricultural and food systems mostly rely on a few species and within these species only a limited number of varieties. Diversification is key to a more healthy and balanced diet as well as to possible adaptation to the challenges of climate change and newly emerging pests and diseases. Ancient cereals like emmer and einkorn are good alternatives to common wheat, especially under marginal farming conditions. In order to facilitate their cultivation and use, based on a 3-year small plot experiment, the best performing cultivars were selected and re-introduced into on-farm (ÖMKi) and on-station (ATK) trials in 2018, including 9 emmer (7 winter and 2 spring) and 2 einkorn landraces together with 1 registered emmer (as standard) and 3 registered einkorn (Mv Alkor as standard) varieties. The results of the first year of on-farm data show a higher yield of winter emmer cultivars (around 2 t/ha in average), compared to einkorn (1 t/ha in average), some of the landraces being as high yielding as registered varieties of both species. Although locations with their soil quality and agricultural techniques play a major role in the performance of tested cultivars, emmer and einkorn landraces proved to be sustainable alternatives for organic farmers for diversification, also in case of marginal farming conditions.

Introduction: The widespread cultivation of a few species developed for intensive farming has led to a decreased nutritive value of these crops and an increased vulnerability of production systems (Murphy et al. 2008). Re-introducing diversity, mobilisation of genetic resources in our agri-food systems is a complex process, which requires significant adaptation from breeding and farming techniques to food processing and diet patterns. Organic agriculture aiming to regenerate the health of soils, ecosystems, and people, is often outperforming conventional farming in quality (Mie et al. 2017) as well as in diversity (Aher et al. 2012).

Ancient wheat species, especially heterogeneous landraces with a higher tolerance to low-input conditions are good candidates to increase diversity on the field and in human diets while mitigating climate challenges. Emmer and einkorn are heavily underutilised crops, although they both have valuable health benefits with higher protein levels and lower gluten index (Akar et al. 2019), better glycaemic index and higher level of micro-nutrients than those of *aestivum* wheat.

Furthermore emmer and einkorn are considered to be more resistant to diseases than modern wheat (Góral and Ochodzki 2017) and might be cultivated under marginal conditions where wheat cannot be produced in a profitable way. In Hungary today only about 400 hectares are cultivated with einkorn and an even smaller area is used for producing emmer, while there is a growing interest and demand from consumers. In order to enhance the availability of ancient cereal grains and products and to promote the development of a value chain built on emmer and einkorn landraces, in 2018 ÖMKi initiated on-farm and on-station trials. Besides yield, disease resistance and quality tests are conducted, and seed multiplication also takes place on-farm in order to provide sufficient raw material for interested farmers as well as for milling, baking and pasta making tests.

Material and methods: In our on-farm tests 7 winter and 2 spring emmer (*Triticum turgidum* subsp. *dicoccum* Schrank*)* and 2 winter einkorn (*Triticum monococcum* L.) landraces (provided by Pro Specie Rara (Switzerland) and Plant Diversity Centre (NöDiK, Tápiószele, Hungary)) were investigated together with 1 emmer and 3 einkorn varieties registered in Hungary (ATK, Martonvásár, Hungary)). The tests were performed in 2018/2019 and have started for 2019/2020 (data not yet available). All the accessions were tested on-station (ATK Agricultural Institute, Martonvásár) for comparison, under conventional semi-intensive circumstances (60-60-60 kg NPK fertilisation was used before sowing, no herbicide or pesticide were used, weeding was carried out by mechanical harrowing), all accessions were sown in autumn, using 2×50 m^2 plot size for registered varieties, 4×50 m^2 for winter emmer and einkorn landraces and 1×50 m^2 for spring emmer. Each plot was individually harvested, measured, and hulled grain yield was extrapolated from these results. The on-farm trials were located at four organic farms (see Fig. 1). Not all the varieties were tested on every farm. Zselíz organic farm hosted a wider range of accessions. Bugac tested only 2 accessions, while Pásztó and Nagykáta 1 cultivar, respectively. Locations marked with poor or very poor soil type (Fig. 1.) are not suitable for common wheat production. In Zselíz hulled grain yield (t/ha) was extrapolated from measurements performed on 3×1 m^2 sample plots for each variety. The yield of sample plots was measured by pulling out all the plants on the 1 m^2 followed by collecting all the ears from each plant. In Bugac, Nagykáta, and Pásztó the whole plots were harvested and measured, and hulled grain yield (t/ha) was extrapolated.

Results: The first year of the experiment under on-station conditions was more favourable for einkorn, and spring emmer (only tested on-station) than for winter emmer cultivars, moreover, registered varieties over performed most landraces, with yields between 4-6 t/ha (Fig. 1). This might be due to the semi-intensive circumstances, in which landraces are usually not competitive with registered varieties. An exception was the spring emmer landrace (GT 1971), which could perform even slightly better than the tested spring emmer line (NL spring emmer). Among the winter emmer landraces NöDiK emmer (Fig. 2) performed as good as the registered Mv Hegyes (reaching 4 t/ha), over-yielding the other emmer landraces (around 2 t/ha) at this site.

On the contrary to the on-station test, on the majority of the on-farm locations winter emmer accessions were over-yielding einkorn cultivars (Fig. 1.). The low performance of GT 143 and GT 381 in Bugac can be explained with a severe drought period during autumn, hindering germination, and the very poor soil quality at this location. Moreover, on this site the farmer applied an undersowing of honey clover (*Melilotus albus* Medik.). In Zselíz, the plants in each plot were well developed and sufficiently dense. There was no sign of nutrient deficiency or other factors adversely affecting plant development. Weed density was slightly higher than average. The soil quality was good, very rich in nutrients, which caused severe lodging in case of all cultivars. Nevertheless, the majority of the emmer landraces performed well here, in case of GT 831 and GT 1402 the yield was similar or even higher compared to on-station results of the same cultivars. In

Nagykáta, emmer accession GT 1399 produced similar yield on-farm, as experienced on-station. 2018 did not favour any fungal diseases; pathogens infected the accessions only moderately, causing insignificant symptoms on all sites.

Figure 1. Grain yield of winter and spring emmer and einkorn accessions in 2019 at on-station and on-farm locations

Figure 2. NöDiK emmer in Zselíz, June 2019, photo: ÖMKi

Discussion: Emmer and einkorn are underutilised crops, although they are both recognised as healthy cereals. Our results suggest that, in addition to their health benefits, emmer and einkorn landraces are very adaptive; they can be successfully cultivated under marginal growing conditions, which are not suitable for common wheat production. On the other hand, under favourable conditions some accessions can produce up to 4-5 t/ha also in organic cultivation, i.e. as much as registered varieties under conventional semi-intensive conditions. This adaptive capacity makes emmer and einkorn landraces ideal alternatives for diversification in organic farming. Datasets of 2019/2020 will complement our findings, together with information on grain quality results.

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Image:

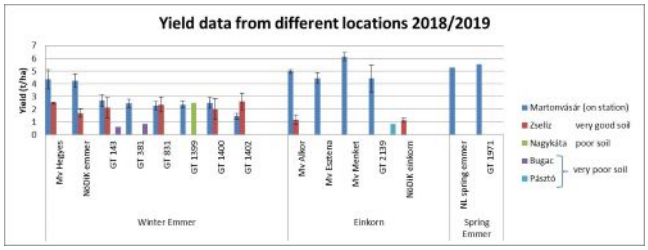

Image 2:

Disclosure of Interest: None Declared

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