How to find a good cereal variety for organic farming?

Kaija Hakala

*Natural Resources Institute Finland (Luke), Management and production of renewable resources, Planta, Tietotie 4, FI-31600 Jokioinen,* [*kaija.hakala@luke.fi*](mailto:kaija.hakala@luke.fi)

**Implications**

Many field crop varieties bred for conventional farming are good also for organic farming. However, success in organic farming requires traits that are not selected for in breeding for conventional farming. These are e.g. good competition ability against weeds and ability to uptake nutrients from sparingly soluble sources. Because of this crop varieties should be tested and also bred under organic conditions. At present, EU offers financing for the efforts to develop and test superior varieties for organic farming market.

**Background and objectives**

The main problems in organic farming are inadequate mineral nutrition, poor competition with weeds and susceptibility to yield failure due to pests and pathogens. Choice of production methods such as good crop rotations, sowing and harrowing technologies and specific fertilizers per crop (Hakala 2013) are required for successful production. The choice of a crop variety suitable for local conditions may introduce better nutrient use efficiency, suppression of weeds and higher resistance and tolerance to pests and pathogens to the system (Hoad et al. 2008, Wolfe et al. 2008). Reliability of yield production in local climatic conditions can also be improved by choice of variety (Hakala et al. 2012, Kahiluoto et al. 2014). There is a large array of varieties bred for conventional agriculture, but a severe lack of crop varieties bred or even tested in organic conditions. EU aims at 100% organic production, including organically produced propagation materials. To increase the incentive to buy more expensive organically produced seed, the farmers should get benefits from using the seed. One way to show the benefits is to offer the farmers seed of superior crop varieties. To do this, we have to find out what are the key traits that improve success in organic farming. We should also study the effects of production in organic environment on the seed and whether the effects are carried on with the seed and affect the production of yield (epigenetic traits).

**Key results and discussion**

Some projects and breeding institutions have already identified a set of key traits for a superior cereal variety for organic farming (Wolfe et al. 2008). The key traits are: weed suppression, earliness (date of germination, date of heading, date of maturity), nutrient use efficiency, root depth, disease resistance, yield quantity, stability and quality and lodging resistance. Weed suppression has been identified to coincide with higher straw length to a certain extent, with increased nitrogen use efficiency following from reduced competition with weeds (Gooding et al. 2012). However, recent field trials show no positive correlation between straw length and root volume. On the contrary, shorter straw usually means more roots and better water and nutrient extraction capacity (e.g. Hoad et al. 2001). Shorter straw also results in higher NUE, as less minerals are required for shoot growth. Modern varieties are often superior not only in conventional high input conditions, but also in low input conditions (Rajala et al. 2016). Because of the overwhelming inputs and success of breeding for conventional farming, the conventional varieties may have valuable qualities that cannot be overlooked in organic farming. However, qualities such as weed suppression through longer straw, early vigor, more horizontal leaf angle, may not have been focus targets in conventional breeding businesses, as chemicals for weed control are routinely used and shorter straw in conventional conditions results in better yield. Pest and pathogen resistance on the other hand are also selected for in the conventional breeding programs, as their control by chemicals is expensive and epidemics difficult to predict. When selecting superior varieties, the tests should contain both modern varieties and older varieties, to answer to challenges of organic farming.

**How work will be carried out**

Selection and breeding of superior crop varieties for organic farming can only be done in organic conditions. EU has launched a Topic “Organic breeding – Increasing the competitiveness of the organic breeding and farming sectors” in Horizon2020 call H2020-SFS-2016-2017 “More resilient and resource-efficient value chains”. A minimum of three projects with a total funding of 20 million euro will tackle the problems in availability of organic sowing seed of suitable varieties for organic conditions. The work will be going on in 2017-2021. Variety tests will be arranged throughout Europe and information about the key traits will become available for EU, Europe and beyond. One of the consortiums is led by Luke.

**References**

Gooding, M.J., Addisu, M., Uppal, R.K., Snape, J.W. & Jones, H.E. 2012. Effect of wheat dwarfing genes on nitrogen-use efficiency. Journal of Agricultural Science 150: 3-22.

Hakala, K., Jauhiainen, L., Himanen, S.J., Rötter, R., Salo, T. & Kahiluoto, H. 2012. Sensitivity of barley varieties to weather in Finland. The Journal of Agricultural Science (Cambridge) 150: 145-160.

Hakala, K. 2013. Organic rapeseed production in Finland. In: NJF Seminar 461: Organic farming systems as a driver for change, Bredsten, Denmark, 21-23 August 2013. NJF Report 9 (3): 137-138.

Hoad, S.P., Russell, G., Lucas, M.E. & Bingham, I.J. 2001. The management of wheat, barley, and oat root systems. Advances in Agronomy 74: 193-246.

Hoad S., Topp C., Davies K. (2008). Selection of cereals for weed suppression in organic agriculture: a method based on cultivar sensitivity to weed growth. Euphytica 163: 355-366.

Kahiluoto, H., Kaseva, J., Hakala, K., Himanen, S.J., Jauhiainen, L., Rötter, R.P., Salo, T. & Trnka, M. 2014. Cultivating resilience by empirically revealing response diversity. Global Environmental Change 25: 186-193.

Rajala, A., Peltonen-Sainio, P., Jalli, M., Jauhiainen, L., Hannukkala, A., Tenhola-Roininen, T., Ramsay, L. & Manninen, O. 2016. One century of Nordic barley breeding: nitrogen use efficiency, agronomic traits and genetic diversity. Journal of Agricultural Science. DOI: <https://doi.org/10.1017/S002185961600068X>

Wolfe, M.S., Baresel, J.P., Desclaux, D., Goldringer, I., Hoad, S., Kovacs, G., Löschenberger, F., Miedaner, T., Østergård, H. & Lammerts van Bueren, E.T. 2008. Developments in breeding cereals for organic agriculture. Euphytica 163:323-346.