How to find a good variety for organic farming
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Implications
Success in organic farming requires traits such as good competition ability against weeds and ability to uptake nutrients from sparingly soluble sources. These are not selected for in conventional breeding. EU offers financing for the efforts to develop and test superior varieties for organic farming.

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. Good crop rotations, efficient sowing and harrowing technologies and specific fertilizers per crop are required for successful organic 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. Reliability of yield production in local climatic conditions can also be improved by choice of variety.
Key results and discussion

A right variety can help when other possibilities are tried – and it helps anyway – as has been known for 100s of years

(Agronomist Väinö Axelson 1908, Finlands Utsädeförenings Föredragsserie 2: 1-13)

Balanced nutrient supply in organic farming relies on manure and legumes – it can be difficult to time the nutrient availability!
Weeds are the worst problem in organic farming.

Hand work would be good but does it pay off? Equipment may be too expensive.
Which variety covers the soil best? In conventional breeding chemical weed protection is assumed. In organic farming a variety with good competition capacity may be crucial.
Which variety can resist pests and pathogens?

Faba bean has been eaten – each leaf with a lace edge.

Could there be varieties that induce production of secondary substances to resist pests?
Which variety has best nutrient use efficiency (NUE)?

Conventional varieties often have superior nutrient use and nutrient uptake qualities. These qualities can be used also in organic farming.

In a large experiment at Jokioinen, Finland, barley varieties from the last 100 years were tested for their NUE. The newer varieties were better than the old ones, despite breeding for chemical fertilizers with easily soluble nutrients.
Which variety gets best nutrients from the soil?

Old varieties had longer straw, but new ones with shorter straw have better NUE. Longer straw does not mean longer roots.

<table>
<thead>
<tr>
<th>Claim</th>
<th>Pot experiment</th>
<th>Field experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is more roots when straw is taller or phytomass greater</td>
<td>yes 8, 9, 10, 11*, 12, 13*</td>
<td>no 6, 11*, 13*, 27</td>
</tr>
<tr>
<td></td>
<td>yes 9</td>
<td>no 2, 45, 14*, 15, 16, 17, 20, 23</td>
</tr>
<tr>
<td>There is more roots when the straw is shorter</td>
<td>11*, 13*</td>
<td>11*, 13*, 27</td>
</tr>
<tr>
<td></td>
<td>17, 18, 19, 20</td>
<td>2, 14, 15, 16, 23</td>
</tr>
<tr>
<td>There is more roots when there is drought or lack of nutrients</td>
<td>3, 9</td>
<td>9, 2, 4</td>
</tr>
<tr>
<td>The shorter the straw the better the yield and nutrient use efficiency</td>
<td>7, 20, 21, 22, 24, 25®, 26</td>
<td>22</td>
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</tbody>
</table>


*depends on the growing conditions and the developmental stage of the crop
$the phytomass doesn’t affect the root weight, but number of tillers does
@there is no consistency, but oldest varieties have longest and biggest roots
®short is better, but taller is needed in organic farming than in conventional farming
An organic variety has to be taller than a conventional variety, to compete better with weeds and thus gaining more nitrogen from the soil, leading to higher NUE. There are limits, though, with height.

For organic conditions, the best NUE result with winter wheat comes with a straw about 90-95 cm, the best NHI (Nitrogen harvest index) result comes with 80-90 cm.

For conventional conditions, the best NUE and NHI results come with a straw about 80 cm

(Gooding et al. 2012, J. Agric. Sci. 150:3-22)
EU is funding variety development and seed promotion for organic farming with 20 million € in calls in 2016-2017. Finland Luke leads one consortium now in the second stage. The result from EU for financing will come in the spring 2018