

# 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.

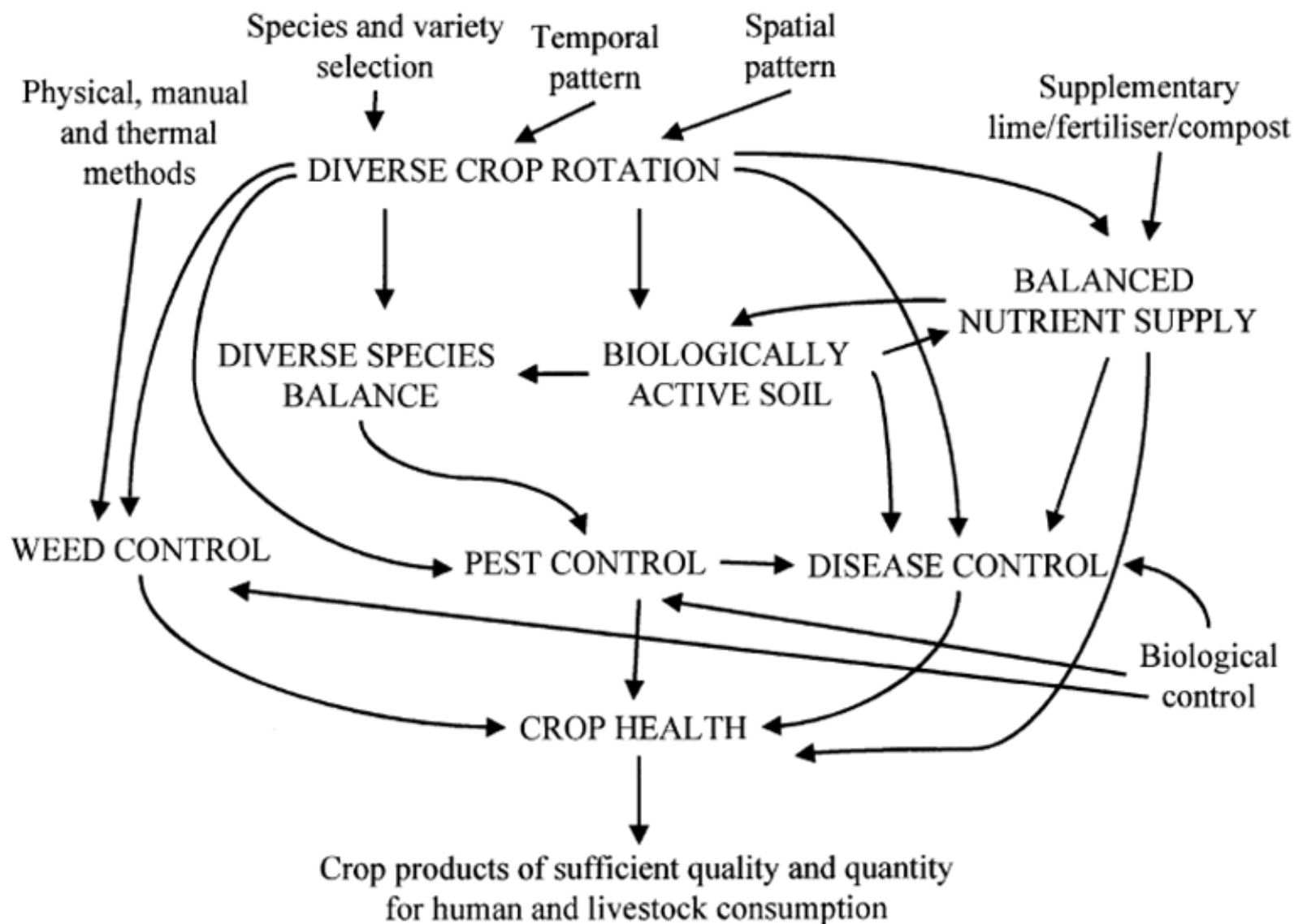
# Key results and discussion

## A right variety can help when other possibilities are tried

– and it helps anyway – as has been known for 100s of years

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E. A. STOCKDALE *ET AL.*



**Figure 5** Flow diagram showing how crop production and crop health in organic farming systems is attained through a combination of structural factors and tactical management.

Så viktiga och hvarandra kompletterande alla dessa omständigheter än äro och så nödvändig enhvar af dem är för ernående af goda resultat vid åkerväxtodlingen, afviker dock frågan om sorturvalet i ett afseende från alla de öfriga. Såväl bättre dikning som bättre gödsling fordra ökade kostnader i samma mån som förbättringsarbetet är effektivare, men bättre växtsorter medföra större inkomster utan att omkostnaderna ökas. Vid ofvan anförda försök hafva de bättre sorterna gifvit större afkastning under samma förhållanden, således med lika utgifter, som de sämsta sorterna gafvo sin dåliga skörd. Det är just denna ökning i nettovinsten, som gifver sorturvalet dess stora betydelse.



(Agronomist Väinö Axelson 1908, Finland's 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?

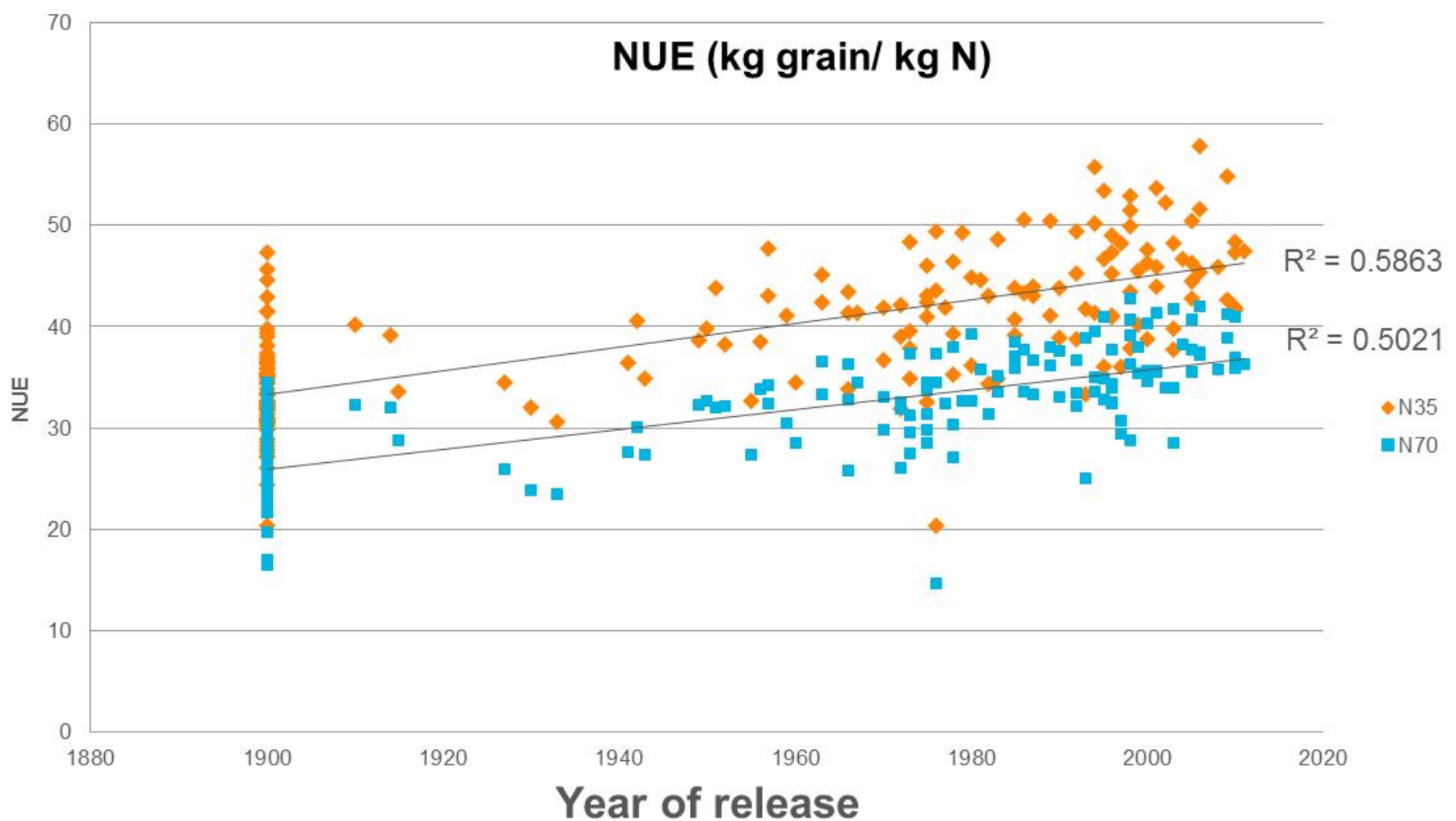
Faba bean has been eaten – each leaf with a lace edge.



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.

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

**References:** 2)Hoad et al. 2001, Adv. Agron. 74: 193-246, 3)Gan et al. 2011, Crop & Pasture Sci 62:457-466, 4)Allard et al. 2013, Eur. J. Agron. 46: 68-76, 5)Peltonen-Sainio et al. 2011, Soil Use Manag. 27: 229-237. 6)Hakala et al. 2009, Agric. Food Sci. 18: 366-387, 7)Mäkelä et al. 2008, Agric. Food Sci 17: 289-306, 8)Mac Key 1973, Proc. 4th Int. Wheat Gen. Symp.: 827-842, 9)Mac Key 1979, Int. Rice Res. Conf., IRRI, Apr. 1979, 10)Mac Key 1988, Proc. 3rd Int. Oat Conf.: 340-344, 11)Hashmi 1980, Pak. J. Agric. Res. 1: 86-89, 12)Waines & Ehdaie 2007, Ann. Bot. 100: 991-998, 13)Bush & Evans 1988, Field Crops Res. 18: 243-270, 14)Siddique et al. 1990, Plant & Soil 121: 89-98, 15)Cholick et al. 2007, Crop Sci. 17: 637-640, 16)Holbrook & Welsh 1980, Crop Sci. 20: 244-246, 17)Miralles et al. 1997, Plant & Soil 197: 79-86, 18)Chloupek et al. 2006, Theor. Appl. Gen. 112: 779-786, 19)Lopes et al. 2012, Crop Sci. 52: 1123-1131, 20)Pask & Reynolds 2013, Crop Sci. 53: 2090-2104, 21)Mathews et al. 2006, Crop Sci. 46: 603-613, 22)Butler et al. 2005, Crop Sci. 45: 939-947, 23)Wojciechowski et al. 2009, J. Exp. Bot. 60: 2565-2573, 24)Trethowan et al. 2001, Field Crops Res. 70:167-176, 25)Gooding et al. 2012, J. Agric. Sci. 150: 3-22, 26) de Rocquigny et al. 2004, Crop Sci 44: 2116-2122, 27) McCaig & Morgan 1993, Can. J. Plant Sci. 73: 679-689.

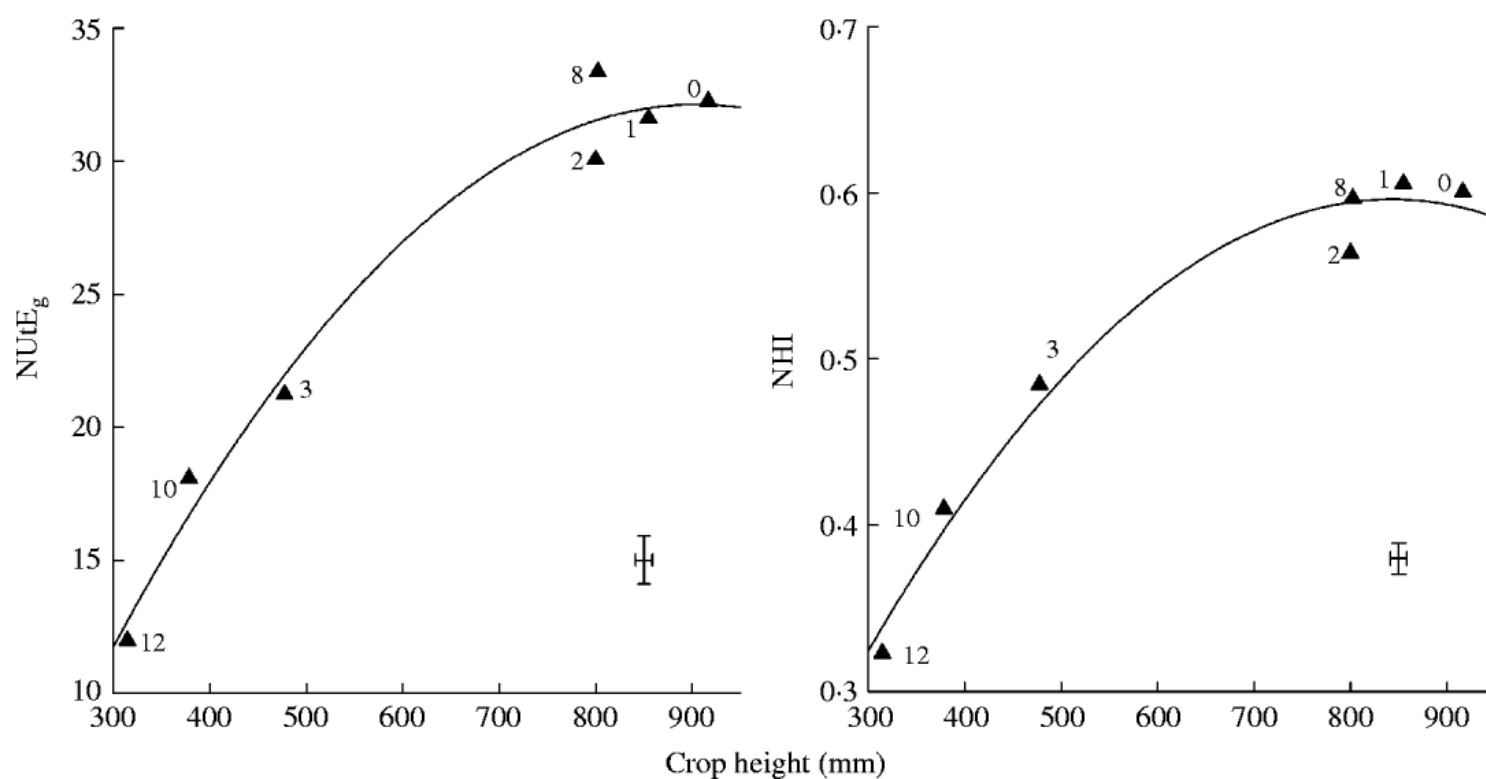
\*depends on the growing conditions and the developmental stage of the crop

§the phytomass doesn't affect the root weight, but number of tillers does

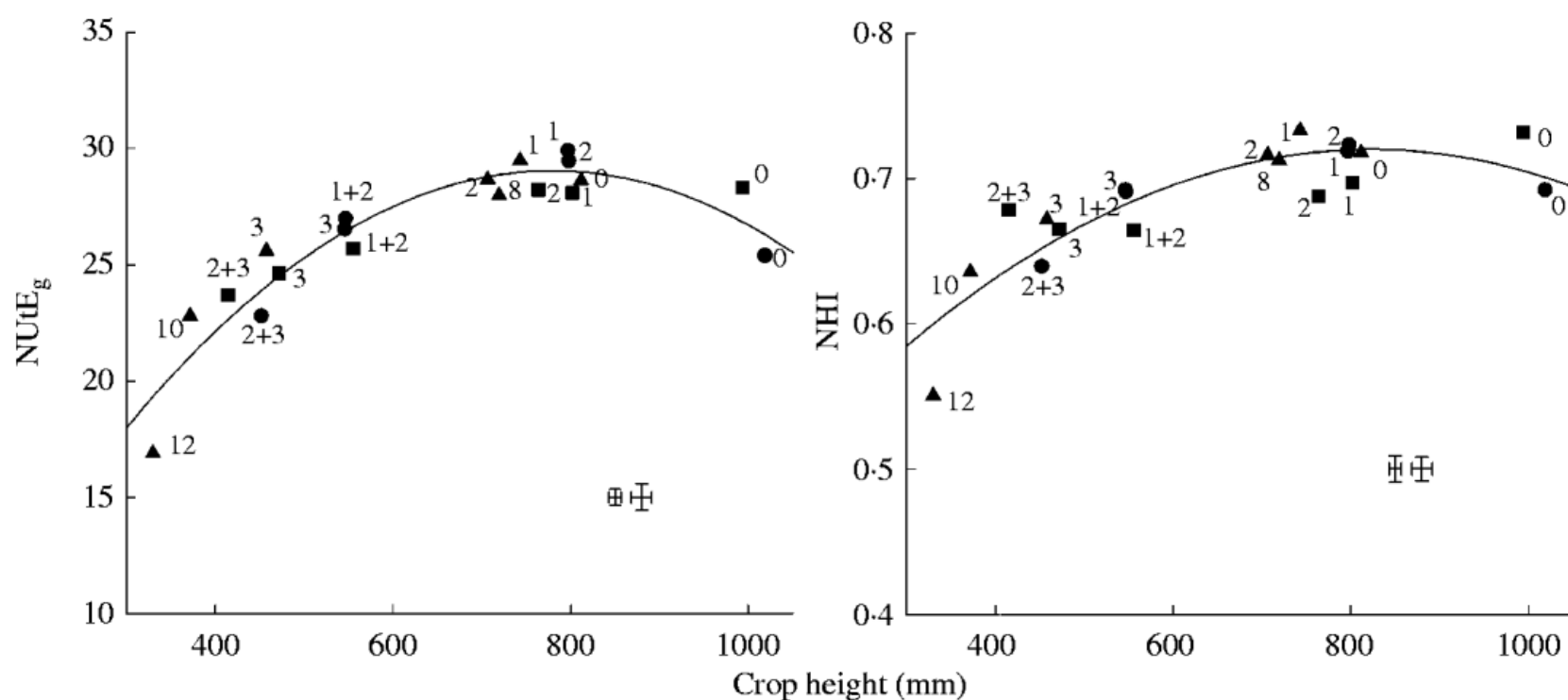
#there is no consistency, but oldest varieties have longest and biggest roots

@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



**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**

