

Field trials shows minor effect of modern plant breeding on grain yield of spring wheat at organic agriculture conditions

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The grain yield in cereals has increased considerable since the beginning of modern plant breeding 150 years ago. Plant breeding has to increasing extent focused on conventional high input agriculture, and little is known about the effect of modern varieties compared with older varieties at low input conditions.

Field trials with 32 varieties bred before 1950 and compared with 25 high quality varieties on the current EU-list of approved varieties over two years were carried out at the organically managed farm Mørdrupgård at Zealand, and Gl.Estrup, Jutland, Denmark.

There was a significant correlation between yield and protein content in both modern ($r^2=0,66$) and older varieties ($r^2=0,35$), with the older varieties having higher protein content than modern varieties. When compensated for differences in protein content, modern varieties had an average grain yield 3.6% higher than the older varieties, but older varieties had in average 11.5% higher loaf volume in baking test indicating that the minor increase observed in modern variety grain yield has been achieved on the expense of the baking quality. The highest grain yield and highest protein yield per area unit were found among modern varieties with low protein content.

The main effect of breeding on grain yield in modern agriculture are believed to be resistance to lodging at high nitrogen conditions, but also resistance to plant diseases, translocation of nutrients from the straw to the seed, and decrease of root exudate leaching contribute to a higher grain yield in modern cereal varieties. At low input conditions, the resistance to lodging contribute little, if at all to increased grain yield, and a number of plant diseases and pests are of minor importance at lower nitrogen level in the plant tissue. Therefore, the main contribution of plant breeding to improved grain yield in high input agriculture has only minor effect on grain yield at low input conditions.

Huge differences between varieties were observed in gluten content and in baking quality. At low input conditions, the baking quality of the variety are more important than the differences in grain yield relative to the importance at high input conditions, where the yield impact of the variety are bigger.

It cannot be generally recommended to use older varieties unless quality aspect are reflected in the price, but some old varieties were compatible with the commonly grown modern varieties. The results calls for targeted breeding for low input conditions, as breeding for high input condition contribute little to the benefit of organic agriculture and other low input conditions. Research is needed to quantify the effect of the different yield components of breeding on grain and straw yield and quality at low input conditions.

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