

Is the Root System a Significant Factor when Selecting Wheat of Barley Varieties?

V. DOSTAL, O. CHLOUPEK and T. STREDA

Introduction

Nowadays growers choose wheat and barley varieties based on their resistance to diseases or their quality parameters important for a specific processing purpose (wheat's baking quality, barley's quality raw material for malt production etc.), and primarily according to the yield.

The root system is necessary for a plant's nutrients and water intake. However, it is not clear what the root system size should be in relation to the yield and environmental conditions. The continental nature of the middle Europe's climate is typical of irregular distribution of precipitation coupled with frequent dry spells on the majority of vegetation. Therefore, it is important to pay appropriate attention to the root system.

In the field conditions, it is not easy to estimate the root system size (RSS) without causing harm to the plants. We managed (CHLOUPEK 1977) to work out a root system size evaluation method by using the means of the root system's electrical capacity. This capacity is measured in relation to the soil in which the roots are growing. The evaluation method is considered prospective by DALTON (1995). Moreover, it was proven useful for the evaluation of maize (BEEM et al. 1998), apple trees (PSARRAS and MERWIN 2000), and poplar trees (PRESTON et al. 2004). The method enabled us to locate five quantitative traits loci (QTL) for the barley's root system size, some of which are related to the yield of the grain (CHLOUPEK et al. 2006).

Methods

The size of the winter wheat and spring barley's root system is measured in the course of three vegetation phases - shooting, heading, grain filling on two localities (Hrubčice, Želešice). 20 varieties in 4 repetitions are assessed on each locality.

The plants were sowed in spacing of 10 x 10 cm, there are 10 plants in each row. We use 6 middle plants from the rows for the RSS estimation. The electrical capacity is measured in nanofarads (nF) by the means of a measuring device called LCR METER ECL 131 D.

Results

The relation between the RSS and the gene for general resistance to *Blumeria graminis* and the spring barley semi-dwarf gene was found by the means of genetic mapping. On the third chromosome, there were genes for a greater RSS in one locus in linkage to the semi-dwarf gene *swd 1*. On the fourth chromosome, there was one locus for a smaller RSS very close to the gene (*mlo*) for general resistance to *Blumeria graminis*. The malting quality of double-haploid lines (DH) was also influenced by a greater RSS. As for the selected malting quality parameters, the great RSS lines had higher extract content by 0.98% and higher sugar extract from malt by 1.55%, however the relative extract was lower by 3.80% etc..

In 2007, the root system size of wheat was affected primarily by the locality (83-86%) - the varieties' average values were smaller in Želešice than in Hrubčice where higher doses of nitrogen were applied (130 kg.ha⁻¹). Additionally, the varieties were highly significant sources of variability and participated by 8-10% of the whole variability of the acquired data. The interaction of the varieties with localities was significant only during the flowering phase when it shared 4% of the whole variability.

Furthermore, we confronted the root system size with the baking quality of varieties (E - superior, A - high quality, B - normal quality and C - feed grain). The lowest quality varieties had conclu-

sively greater RSS than the E, A and B groups of baking varieties. No significant differences between E, A and B groups were found. In the group of superior varieties, the *Akteur* variety had a greater RSS (in all three terms) than the average value of all twenty monitored varieties. During the heading time, it was even greater than the average values of all group C varieties.

Conclusion

The root system size (RSS) of spring barley was influenced predominantly by the environment (42-81%). However, it was also affected by the variety (7.9-11.2%) and additionally, it had an effect on the malting quality (higher extract content etc.). The preliminary results acquired on two localities have proven that twenty winter wheat varieties significantly differed in RSS. The varieties' percentage of the whole variability was 8-10%, so it provides a sufficient variability for a effective breeding for a greater RSS. Low baking quality was connected to a greater RSS.

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Autoren: Ing. Vitezslav DOSTAL V., O. CHLOUPEK and T. STREDA, Mendel University of Agriculture and Forestry, Zemedelska 1, CZ-61300 BRNO, dostalvita@seznam.cz

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