Small grains varieties developed at the Maize Research Institute, Zemun Polje

Vesna KANDIĆ¹, Dejan DODIG¹, Desimir KNEŽEVIĆ²

¹Maize Research Institute “Zemun Polje”, Slobodana Bajića 1, 11185 Belgrade, Serbia, (e-mail: vkandic@mrizp.rs)
²University of Prishtina, Faculty of Agriculture, Jelene Anžujske b.b., 38228 Zubin Potok, Serbia

Abstract

The most important agronomic and technological traits of the following five small grains varieties developed at the Maize Research Institute, Zemun Polje, were presented in this study: Apolon (spring hulless barley), Nektar (winter two-row malting barley), Zlatna (late maturity winter wheat), Zemunska rosa (early maturity winter wheat) and Zenit (winter triticale). These varieties were released by the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia in 2008 and 2009. The two-year average yields of the varieties Apolon, Zemunska rosa and Zenit were the highest, while the yield of Nektar and Zlatna was at the level of the check yield, but they had exceptional technological quality. All varieties showed a good resistance to low temperatures and plant pathogens. The basic property of newly developed varieties is high genetic yielding potential and stable yield, which was successfully combined with high technological quality and/or high tolerance to drought.

Key words: variety, small grains, agronomic and technological traits

Introduction

The development of new, improved varieties adapted to drought conditions is a fundamental aim of the selection programme on small grains at the Maize Research Institute, Zemun Polje. Beside the spring hulless barley variety Apolon, released by the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia in 2008, the varieties Nektar (winter two-row malting barley), Zlatna (late maturity winter wheat), Zemunska rosa (early maturity winter wheat) and Zenit (winter triticale) were released in 2009. Breeders need varieties that are resistant, or at least tolerant, to locally important diseases, drought, etc., and well adapted to the local climate and ripen at a convenient time (Briggs, 1998). Grain yield is a complex trait in which formation are included yield components that directly or indirectly depend on many agronomic traits: resistance to low temperatures and lodging, intensity and duration of the photosynthetic activity, resistance to diseases, etc. The objective of the present study was to present some of the most important agronomic and technological traits of varieties released in 2008 and 2009 in relation to their checks at the Commission for the Variety Releasing.

Materials and methods

The study encompasses results on recently developed lines in two-year trials of the Commission for the Variety Releasing of the Republic of Serbia carried out in six locations (Kragujevac, Novi Sad, Pančevo, Sremska Mitrovica, Sombor, Zaječar). Trails were set up according to the randomised complete-block design. The elementary plot size amounted to 5m2. Agronomic, physical, chemical and technological traits of varieties were observed. Physical, chemical and technological analyses were performed at the Faculty of Technology in Novi Sad. Tolerance to plant diseases was evaluated in the adult-plant stage under conditions of artificial inoculation and was expressed in% of diseased plants. Resistance to low temperatures was observed in cold storages, and was expressed in% of survived plants. The determination of morphological, physiological, productive and traits of quality was done by widespread methods. Statistical data processing
was performed by the MSTAT-C program.

Results and discussion

The spring hulless barley variety Apolon was developed by the derivation of a homozygous line from IWHBON’97 (CIMMYT). As presented in Fig. 1, on the average for all years and locations the variety Apolon had a yield of 4587 kg ha⁻¹, or higher by 774 kg ha⁻¹ than the yield of the check variety Golijat, which is a statistically very significant difference (P<0.01). The highest two-year average yield (5594 kg ha⁻¹) was recorded in Zaječar.

Hulless barley has a special importance in the production of novel and functional food. According to Škrbić et al. (2009), β-glucans are recognised as having important positive health impacts, centred on their benefits in coronary heart disease, cholesterol lowering and reducing a glycaemic response. Inclusion of barley flour in plain wheat bread formulation enhances the β-glucan content of bread, which may have a beneficial effect on human health. In relation to hulled varieties, hulless ones have more proteins, dietary fibres and β-glucans. The β-glucan, i.e. protein content in the variety Apolon amounted to approximately 5.6%, i.e. 17.3%, respectively. Hulless barley varieties should also have good physical traits of kernels (large, well filled with white aleurone) and a high content of dietary fibres. The essential property of hulless barley varieties is very higher% of hulles kernels, which amounted to approximately 95% in the variety Apolon, while% of the first-class kernels (8.3%) was higher than in the check Golijat (7.9%). The most important agronomic traits of the variety Apolon are presented in Tab. 1.

![Figure 1. The two-year (2007-2008) grain yield of the variety Apolon obtained in the trials of the Commission for the Variety Releasing](image)

<table>
<thead>
<tr>
<th>Trait</th>
<th>Apolon</th>
<th>Golijat</th>
<th>Nektar</th>
<th>NS 525</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000-kernel weight (g/DM)</td>
<td>25.3</td>
<td>25.7</td>
<td>46.2</td>
<td>45.2</td>
</tr>
<tr>
<td>Test weight (kg hl⁻¹)</td>
<td>76.10</td>
<td>75.05</td>
<td>75.25</td>
<td>73.85</td>
</tr>
<tr>
<td>Resistance to low temperatures (%)</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>40</td>
</tr>
<tr>
<td>Resistance to <em>Erysiphe graminis hordei</em> (%)</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>Resistance to <em>Puccinia hordei</em> (%)</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Heading time</td>
<td>-2.8</td>
<td>-</td>
<td>+4.75</td>
<td>-</td>
</tr>
<tr>
<td>Plant height (cm)</td>
<td>83.1</td>
<td>79.9</td>
<td>93.0</td>
<td>90.4</td>
</tr>
<tr>
<td>Logging</td>
<td>2.2</td>
<td>2.0</td>
<td>2</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Resistance: % of infection; Heading time: +after and - before the check

The two-row malting barley variety Nektar was developed by crossing NS-183 x (Iris x Alpina) x Novum. The pedigree selection method was applied. As it shown in Fig. 2, the average yield in all locations and years amounted to 8797 kg ha⁻¹, which was higher by 80 kg ha⁻¹ than the average yield of the check variety Novosadski 525. The highest yield of the variety Nektar (9824 kg ha⁻¹) was recorded in the location of Pančevo.
The 1000-kernel weight amounted to 46.2 g/DM in the variety Nektar (vs. 45.2 g/DM detected in the check). Furthermore, the test weight of the natural sample of this variety was greater than the test weight of the check (75.25kg vs. 73.85kg). Grading is an important characteristic from the economical point of view. Grading indicates proportionally this part of the grain yield which remains to the 2.5 and 2.8 mm sieve (Küüts, 1992; Kunze, 1996) and this part is used for malting. The first-class kernels in the variety Nektar amounted to 95.3% of the total grain yield. Other agronomic traits are presented in Tab. 1. Results of trials of the Commission for the Variety Releasing show that the grain protein content amounted to 10.2% (vs. 14.6% in the check) and the content of fine extract amounted to 75.02% (vs. 75.63% in the check).

The wheat variety Zlatna was derived by crossing varieties Jasenica and Rodna. The pedigree selection method was applied. The average yield in all locations and years, is presented in Fig. 3, and amounted to 8967 kg ha⁻¹, which was higher by 216 kg ha⁻¹ than the average yield of the check variety Pobeda. The highest yield (10448 kg ha⁻¹) of this variety was detected in the location of Novi Sad.

The variety is late maturity one. The variety Zlatna had a great test weight (84.6 kg hl⁻¹), and according to Mladenov et al. (2008), that is an important parameter of technological quality and depends on grain filling, chemical composition, kernel area, nature of admixtures and moisture. Total extraction amounted to 78.9%. Based on the protein content (13.8%) and the sedimentation value (47 ml) it belongs to the first quality class. According to quality parameters the variety Zlatna is an enhancer. The bread volume yield (ml/100g flour) amounted to 582, while loaf quality was 6.3. The most important agronomic traits are presented in Tab. 2.
The winter wheat variety Zemunska rosa was developed by crossing varieties Skopljanka (Macedonia) and Proteinka (Serbia), by the application of the pedigree selection method. As presented in Fig. 3, on the average for all years and locations, the yield of this variety amounted to 9575 kg ha\(^{-1}\), which was higher by 918 kg ha\(^{-1}\) than the yield of the check variety Renesansa. This difference was statistically significant. The variety Zemunska rosa is tolerant to drought. The average yield recorded in dry 2008 was higher by 9.3% the average yield detected in 2009 that was characterised with the usual amount of precipitation. In 2008, the average yield of the variety Zemunska rosa was higher by 5.27% than the yield of the check Renesansa. Kernels of the variety Zemunska rosa were large and well filled, the 1000-kernel weight amounted to 44.3 g/DM, while the test weight of the clean kernel was 83.7 kg hl\(^{-1}\). This is an early maturity variety with good resistance to low temperatures and strong resistance to plant pathogens. According to Shu et al. (2008), disease resistance is one of the most important traits for the development of sustainable agriculture and the use of resistant varieties is the most economical and environmentally safe way of controlling these diseases.

The winter triticale variety Zenit was developed by crossing varieties Knjaz (Serbia) and Alzo (Poland) by the application of the pedigree selection method. On the average for all years and locations, the yield of this variety amounted to 9033 kg ha\(^{-1}\), which was significantly higher than the yield of the check KG20 (7960 kg ha\(^{-1}\)). As presented in Fig. 4, the highest average yield of this variety (10560 kg ha\(^{-1}\)) was registered in the location of Novi Sad. This variety was also tolerant to drought and its average yield in dry 2008 was higher by 12% than the average yield in 2009. Moreover, in comparison with the variety KG20, the variety Zenit had an average yield higher by 13.7% in 2008.

Besides, the improvement of quality, enhancing resistance to diseases and insects, as well as, to drought and heat stress are also important. The variety Zenit had excellent resistance to low temperatures with 80% of survived plants (vs. 20% in the check). It had exceptional resistance to leaf and stem rust (infection of 0% vs. 5% in the check). This variety had a tall stem (122.3 cm), and therefore it could be used for silage. Although the stem was higher by 13.8 cm than the height of the check, the number of lodged plants was 1.6 (vs. 1 in the check). The 1000-kernel weight amounted to 32.6 g/DM. The test weight of clean kernels was 188.8 kg hl\(^{-1}\), which was greater than the test weight of the check (182.9 kg hl\(^{-1}\)).

**Conclusions**

The breeding programme of the Maize Research Institute, Zemun Polje, encompasses almost all kinds and types of small grains. High yields of five recently released varieties are successfully combined with high technological quality and/or high tolerance to drought, hence these varieties can be grown under different agroecological regions.
References


sa2011_0316