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Genetics and Breeding

Production potential of new triticale varieties grown in the region of Dobrudzha

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Abstract. The production potential of the new triticale varieties Kolont, Accord and Respect were investigated in a three-year field experiment (2009 – 2011) carried out in the trial field of Dobrudzha Agricultural Institute, General Toshevo (DAI). The experiment was designed by the split plot method in 4 replications, the size of the trial plot being 12 m². The investigation involved four predecessors – oilseed rape, pea, sunflower and maize, and three fertilization norms according to the type of predecessor. The effect of some agronomy factors: the year conditions, the type of predecessor and the norm of fertilization, on the formation of yield, test weight, and 1000 grain weight of the new triticale varieties was analyzed. It was found that the year conditions and the level of mineral fertilization were the decisive factors for the formation of the yield of these varieties. Test weight was influenced to the highest degree by the year conditions and the genotype. The environment was determining for 1000 grain weight, while the genotype and the fertilization norm of mineral fertilization had similar effect. The new genotypes were responsive to fertilization, the tiered increase of the nitrogen fertilization norm leading to analogous higher productivity. During the years of investigation all three varieties gave high yields; varieties Accord and Respect had the highest test weight, and varieties Kolorit and Accord – the fullest grain with the largest size.

Keywords: triticale, variety, fertilization, predecessor, year

Abbreviations: Yields – grain yield, TestW – test weight, TKW – thousand grain weight

Introduction

Two of the most ancient cereal plants – wheat and rye, which nature provided to humankind as sources of nutrition, differ significantly by their biological and economic properties. The combination of positive traits in a single plant organism, the artificial cereal crop triticale, is a remarkable progress in plant breeding (Kirchev, 2006; Kolev, 2010). Triticale is an intensive and highly productive crop which requires high level of the applied agronomy practices to realize its production potential. The testing of new triticale cultivars under different agro ecological conditions is important for high yield with good quality of grain (Santiveri et al., 2004; Kirchev et al., 2007; Tanchev, 2007; Marton, 2008; Irani et al., 2010).

The aim of the investigation was: 1) to analyze the effect of main agronomy factors on the formation of the production potential of the new triticale genotypes; 2) to present their production potential by levels of the agronomy factors

Material and methods

The investigation was carried out in the trial field of Dobrudzha Agricultural Institute, General Toshevo (DAI) for a three-year period (2008 – 2011). The trial was designed by the split plot method in 4 replications, the size of the trial area being 12 m². The object of investigation was three new triticale cultivars developed at DAI (Baychev, 2006; Baychev and Petrova, 2009, 2011). The investigation involved four predecessors: oilseed rape, pea, sunflower and maize, and three norms of mineral fertilization according to the type of predecessor. Thus the applied norms of mineral fertilization were the following:

- T1 (N P K) – check variant;
- T2 (N P K) after pea and N P K after the other investigated predecessors;
- T3 (N P K) after pea and N P K after the other investigated predecessors;
- T4 (N P K) after pea and N P K after the other investigated predecessors.

The following traits were analyzed: grain yield (t ha⁻¹), test weight (kg), 1000 grain weight (g).

The statistical processing of data was done with the help of Statistica 7.

The meteorological conditions during the years of the experiment (2009 – 2011) were compared to the climatic norm at DAI (1952 – 2011) (Figure 1). In the first year (2008 – 2009), the amount of rainfalls during the entire growing season was lower than the precipitation norm. An exception was observed during the winter months (January) when the crops were dormant; more significant was the deviation in April and July (exceeding the precipitation norm by 17.6 mm and 18.1 mm). The first year of the investigation was warmer in comparison to the long-term period. The measured mean monthly temperatures were higher than the temperature norm. The second year of the investigation (2009 – 2010) differed considerably because the total amount of vegetation rainfalls exceeded by 319.7 mm the mean values of the long-term period. During the entire growing season the amounts of rainfalls were higher than the precipitation norm, with the exception of February, March and June.
The recorded mean monthly temperatures were higher than the temperature norm. In the third year of the experiment (2010–2011) the amounts of rainfalls during the entire growing season were lower (422.9 mm) in comparison to the precipitation norm (439.4 mm). There were high variations of the meteorological conditions at the beginning of the growing season as compared to the climatic norm. Immediately before planting in October, the rainfalls were abundant (exceeding the precipitation norm by 18.0 mm), and the recorded mean monthly temperature was 2°C lower than the temperature norm. November was drier, with rainfalls 20.7 mm below the precipitation norm but the mean monthly temperature was very high (5.9°C higher than the temperature norm). The tendency during April–May was also different: the recorded mean monthly temperature was with almost a degree lower, and in July, when triticale is harvested, the temperature was 1.9°C higher than the norm. On the whole, variable conditions for growth and development of triticale were observed in all three years of the investigation.

![Figure 1. Meteorological conditions](image)

**Results**

The analysis of variances showed significant effects of the agronomy factors on the investigated traits, both independent and resulting from their interactions (Table 1). The year conditions had the strongest effect on the test weight of the new triticale cultivars (20%) and considerable effect on the formation of their yield (46%).

![Graph](image)

The meteorological conditions influenced to a very low degree the yield of the new triticale cultivars (22%). The role of the genotype was markedly expressed on the traits test weight (13%) and absolute weight (10%). According to the multifactor analysis, the type of predecessor had lower effect on the investigated indices, although its role was resulting from their interactions (Table 1). The year conditions had lower effect on the investigated indices, although its role was resulting from their interactions (Table 1). The year conditions had lower effect on the investigated indices, although its role was resulting from their interactions (Table 1). The year conditions had lower effect on the investigated indices, although its role was resulting from their interactions (Table 1). The year conditions had lower effect on the investigated indices, although its role was resulting from their interactions (Table 1).

**Table 1. Anova of investigated factors**

<table>
<thead>
<tr>
<th>Source</th>
<th>Yields</th>
<th>TestW</th>
<th>TKW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SS</td>
<td>%</td>
<td>SS</td>
</tr>
<tr>
<td>Corrected Model</td>
<td>592.669</td>
<td>0.00</td>
<td>3357.593</td>
</tr>
<tr>
<td>{1} Year</td>
<td>270.951</td>
<td>0.00</td>
<td>2688.791</td>
</tr>
<tr>
<td>{2} Variety</td>
<td>1.713</td>
<td>0.00</td>
<td>445.312</td>
</tr>
<tr>
<td>{3} Predecessor</td>
<td>37.725</td>
<td>0.00</td>
<td>11.349</td>
</tr>
<tr>
<td>{4} Fertilization</td>
<td>101.303</td>
<td>0.00</td>
<td>116.480</td>
</tr>
<tr>
<td>1'2</td>
<td>7.496</td>
<td>0.00</td>
<td>13.465</td>
</tr>
<tr>
<td>1'3</td>
<td>93.866</td>
<td>0.00</td>
<td>7.358</td>
</tr>
<tr>
<td>2'3</td>
<td>0.499</td>
<td>0.703</td>
<td>1.313</td>
</tr>
<tr>
<td>1'4</td>
<td>13.418</td>
<td>0.00</td>
<td>11.344</td>
</tr>
<tr>
<td>2'4</td>
<td>17.698</td>
<td>0.00</td>
<td>12.907</td>
</tr>
<tr>
<td>3'4</td>
<td>17.715</td>
<td>0.00</td>
<td>13.618</td>
</tr>
<tr>
<td>1'2'3</td>
<td>0.891</td>
<td>0.870</td>
<td>6.889</td>
</tr>
<tr>
<td>1'2'4</td>
<td>8.566</td>
<td>0.00</td>
<td>10.702</td>
</tr>
<tr>
<td>1'3'4</td>
<td>18.150</td>
<td>0.00</td>
<td>8.389</td>
</tr>
<tr>
<td>2'3'4</td>
<td>1.174</td>
<td>0.961</td>
<td>3.417</td>
</tr>
<tr>
<td>1'2'3'4</td>
<td>1.505</td>
<td>1.00</td>
<td>6.258</td>
</tr>
<tr>
<td>Error</td>
<td>26.263</td>
<td>9.920</td>
<td>50.158</td>
</tr>
</tbody>
</table>
the 1000 grain weight (13%), but its effect was insignificant on test weight (3.5%). Among the combined interactions, that of year x predecessor (1*3) was the most significant for the formation of the yield from triticale (16%). The other interactions had low effect on the trait and some of them were not significant. All combined interactions between the agronomy factors were significant for the traits test weight and 1000 grain weight, although their percent was low. The triple combination year x genotype x fertilization (1*2*4) is worth mentioning for its effect on 1000 grain weight (12%). The combined interactions between the agronomy factors had the highest effect on 1000 grain weight as compared to the rest of the traits. Similar results have been presented in our previous publications related to the investigation of these traits in the other winter cereal crops – common wheat (Ivanova et al., 2007; Ivanova and Tsenov, 2009), durum wheat (Ivanova and Tsenov, 2010) and barley (Ivanova and Mihova, 2012).

**Discussion**

In the recent years the Official Varietal List of Bulgaria has been enriched with many new triticale varieties (Baychev, 2006; Baychev and Petrova, 2009, 2011), which can to a high degree help to increase agricultural production (Baychev, 2012). One of triticale’s main and most important advantages is its higher production potential in comparison to the other cereals (Kirchev et al., 2012). The production potentials of the investigated genotypes are given by levels of the agronomy factors (Figures 2, 3 and 4). The year conditions caused variable expression of the production potential of the new triticale cultivars (Figure 2). The cultivars formed lower yields during harvest year 2009, while in 2011 the yields were maximal. The variations between the years were greater than the differences between the cultivars. Thus the variations in the obtained yields were from 5.5 t.ha\(^{-1}\) in cultivar Respect to 5.9 t.ha\(^{-1}\) in cultivar Kolorit during 2009, while in 2011 they reached 8.1 t.ha\(^{-1}\) in cultivar Accord. The values of test weight were the lowest in 2010, the year with very high precipitation, especially before harvesting. In all three years cultivars Accord and Respect had higher values of this index than cultivar Kolorit. A thousand grain weight characterizes grain size. In all three years of the experiment cultivar Kolorit had the fullest grain. Harvest year 2011 was the most favorable for the expression of the production potentials of the new triticale cultivars. They formed high yields with similar values; cultivars Accord and Respect had the highest test weight, and cultivar Kolorit – the largest and fullest grain.

The new triticale cultivars demonstrated variable production potential depending on the type of predecessor (Figure 3). After the legume predecessor, cultivar Accord gave the highest mean yield of 7.6 t.ha\(^{-1}\). After the other predecessors (oilseed rape, sunflower and maize), the genotypes Kolorit and Respect formed significantly higher yields. The test weight of cultivars Accord and Respect was much higher after all predecessors in comparison to cultivar Kolorit. The variation of values was not high: from 70.9 kg to 71.2 kg. A thousand grain weight of cultivar Kolorit and Accord was higher after all predecessors, the values being greater after oilseed rape and pea. Averaged for all predecessors, cultivars Kolorit and

![Figure 2](image_url) Yields, TestW and TKW of the investigated cultivars over years

![Figure 3](image_url) Yields, TestW and TKW of the investigated cultivars according to predecessors
Respect formed the highest grain yield, cultivars Accord and Respect had maximum test weight, and cultivars Kolorit and Accord – the largest and fullest grain.

Fertilization is a significant and dynamic part of the growing technology. The applied norms of mineral fertilization had multidirectional effect on the production potential of the new triticale cultivars (Figure 4). Naturally, the check variants (T1) gave the lowest grain yield. The applied tiered increase of the nitrogen norm caused tiered increase of productivity in cultivars Kolorit and Accord to the last fertilizer level. In cultivar Respect similar increase of productivity was observed, but in this case the high fertilizer norm maintained it at the same level; maximum yield was obtained from the check variants even without fertilization. Test weight was the highest in the variants without fertilization and decreased after the applied mineral fertilization. Cultivars Accord and Respect had the highest values of this trait. A thousand grain weight was also the highest in the check variants, decreasing in the fertilizer variants. Cultivars Kolorit and Accord were with the highest values of this index. In the variants without fertilization the highest yields were obtained from cultivar Respect. The use of mineral fertilization increased the productivity of the investigated triticale cultivars, the variations between them being not very high. Cultivars Accord and Respect had the highest test weight, and Kolorit and Accord were with the largest and fullest grain.

Conclusions

The year conditions and the level of mineral fertilization were decisive factors for the formation of yield from the new triticale cultivars. Test weight was most affected by the year conditions and the genotype. The environment was determining for 1000 grain weight, and the genotype and the mineral fertilization norm were with similar effects.

The new genotypes demonstrated excellent responsiveness to fertilization, the tiered increase of the nitrogen norm leading to increase of productivity. During the years of the investigation all three cultivars gave high yields, cultivars Accord and Respect had the highest test weight, and Kolorit and Accord – the largest and fullest grain.

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