GENOTYPIC PLASTICITY AND STABILITY OF YIELD COMPONENTS
IN TRITICALE (x Triticosecale Wittm.)

Hristofer KIRCHEV, Rumyana GEORGIEVA

Agricultural University, Faculty of Agronomy, 12 Mendeleev Blvd., 4000 Plovdiv, Bulgaria

Corresponding author email: hristofer_kirchev@abv.bg

Abstract

In order to establish genotypic plasticity and stability of the yield components in triticale, data from three years field trial have been used. The main structural yield components (number of spikes per m²: plant height, cm: spike length, cm: number of grain per spike; mass of grain per spike, g) of five triticale varieties are determined. The modified model of Eberhart and Russel was applied. The coefficients of the linear regressions bᵢ characterize the average variety reaction to changes in the climatic conditions, show his plasticity and give opportunity to prognosticate the researched parameter in the range of the investigated conditions. The main parameter, which estimates the variety stability, is the dispersion Sᵢ. The more the dispersion of the stability Sᵢ to zero tends, the less the empirical values of the signs distinguish from the theoretical values, located on the regression line. The plasticity of the indicator Nr. of spikes/m² is with the highest values by the varieties AD-7291, Sadovec and Rakita. According to the varieties Rojen and Zaryad this indicator is with lower values. By the both linear parameters – Plant height and Spike length the triticale varieties react on the same way. The triticale varieties react to the environmental conditions and to the components Nr. of grain/spike and Mass of grain/spike almost equally. The stability values are contrariwise proportional to the varieties plasticity regarding the components Nr. of spikes/m² Plant height and Spike length. According to the both signs, related to the grain (Nr. of grain/spike and Mass of grain/spike) no similar tendencies are have been observed. The yield plasticity coefficient correlates positive with all yield components. By the yield stability coefficient there is a positive correlation by the Nr. of spikes/m² and the Mass of grain/spike, and negative by the component Plant height.

Key words: triticale, plasticity, stability, yield components.

INTRODUCTION

Genetically triticale (x Triticosecale Wittm.) is an amphiploid produced by crossing the genomes of two different species - wheat and rye. The first hybrids are fertile progenies arose from an intergeneric (interspecies) hybridization and followed by chromosome doubling between a female parent from the genus Triticum and the male parent from the genus Secale. The majority of the today’s varieties are descendants of a primary hybrids, which involve either common (Triticum aestivum L., 2n=42=AABBDD) or durum (Triticum durum, 2n=28=AABB) wheat as a female parent and cultivated diploid rye (Secale cereale L., 2n=14=RR) as a male parent (Oettler et al., 2001; Mergoum and Gómez-Machpherson, 2004; Siriamornpun et al., 2004; Varughese et al., 1996; Losert et al., 2017). One from the most basic positive feature of triticale is its high productive potential. This is due to the composition of the yield components inherited from the wheat and rye (Estrada-Campuzano et al., 2012; Gerdzhikova, 2014; Ivanova and Kirchev, 2014; Ivanova and Tsenov, 2014; Royo and Blanco, 1999; Ramazani et al., 2016; Stoyanov and Baychev, 2015).

Namely the big genetic diversity of the created triticale varieties is a requirement for their different reaction to the environmental conditions. This demand to pay attention on their genotypic plasticity and stability.

MATERIALS AND METHODS

For determining the plasticity and stability of the main structural yield components in triticale, data from a two parallel field trials have been used. The one was carried out in the northern Bulgaria in the region of Dobrogea (43°39'33.0"N 28°02'05.5"E), and the other – in the southern Bulgaria, the region of Thracian valley (42°08'26.2"N 24°48'21.1"E). Five varieties have been examined – AD-7291 (standart), Rojen, Sadovec, Rakita and Zaryad.
The genotypic plasticity and stability of the tested varieties are determined by the main structural components, which have bearing on the yield like - number of spikes per m²; plant height, cm; spike length, cm; number of grain per spike; mass of grain per spike, g. Plasticity (bk) and stability (Sk) coefficients are calculated on the basis of the Eberhart and Russel model, 1966.

The model of Eberhart and Russel (1) looks like this:

\[ Y_{ijk} = \bar{Y} + G_i + P_j + rij + eijk \]

where G ist the effect of the genotype, and P – of the investigated region.

There was used two-way ANOVA to define statistically significant differences between the examined varieties. To calculate the dependents between the yield and the investigated signs, correlation analysis have been used.

RESULTS AND DISCUSSIONS

The regression coefficient and the deviations from the regression line were being estimated and so the diffraction can be determined by use of dispersion analysis (Table 1).

The model of Eberhart and Russel can be applied under condition that the interaction „genotype G x region P“ is statistically significant, because it is supposed, that the changes in the feature are based on genetic and plants will change estimated parameter by different environment. To give a mathematical expression of the terms „ecological plasticity“ and „stability“ Eberhart and Russel give them the following definition: under ecological plasticity is to understand the average variety reaction to environmental changes, and under stability – the deviation of the empirical data from this average reaction at any condition of the environment.

The coefficients bk of the linear regressions characterize the average variety reaction to changes in the climatic conditions, show his plasticity and give opportunity to prognosticate the researched parameter in the range of the investigated conditions (Table 2).

Geometrical the regressions coefficients bk can be interpreted as an angular coefficients of the regression straight lines. It is clarified, that by bk increase the variety will be more responsive to the growing conditions. In most cases bk coefficients are positive, but they can also acquire a negative values, as for example yield decrease as result from lodge or disease attack. If the coefficient bk > 0, it means that the variety does not react to the environmental changes.

The plasticity bk of the indicator Nr. of spikes/m², who determine in major ratio the sowing density, is higher than one in the varieties AD-7291, Sadovec and Rakita, as proved the standard AD-7291 is the most plastic. The values of this indicator are lower in the varieties Rojen and Zaryad and the both belong to the same statistical group. According to the both linear parameters – Plant height and Spike length the examined triticale varieties react to the same way. For the most plastic in relation to these signs changes are remarkable the varieties Rojen and Rakita and the varieties Sadovec and AD-7291 are influenced in lower ratio by the environmental changes according the changes in the linear parameters Plant height and Spike length. However, the variety Zaryad reacts different – is more plastic to changes in the Plant height, whereas to the Spike length lower changes are indicated depending on the conditions of the relevant region. Similar to the both previous indicators, the triticale varieties react to the environmental conditions almost on the same way concerning the components Nr. of grain/spike and Mass of grain/spike. The most plastic, regarding the both yield components, are the varieties Rakita and Zaryad, followed by the standard AD-7291, while by Rojen and Sadovec the plasticity of the Nr. of grain/spike and Mass of grain/spike is lowest.

The main parameter, which estimates the variety stability, is the dispersion Sk. The more the dispersion of the stability Sk to zero tends, the less the empirical values of the signs distinguish from the theoretical values, located on the regression line. According to the applied models of Eberhart and Russel, as a goal for „ecological plastic and stable variety“ can be accepted any sort who possess the both values: bk >1 and Sk >0 .

Rates of dispersion Sk which define the variety stability, are in the present research positive in every varieties and at any yield components, what according to Eberhart and Russel them as stable determine, concerning the received yield components (Table 3).
Geometrical the regressions coefficients $b_k$ can regress the researched parameter in the range of the plasticity and give opportunity to prognosticate changes in the climatic conditions, show his characterize the average reaction to from this average reaction at any condition of stability

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There was used two-way ANOVA to define the effect of the genotype, and

$$P - \text{genotype} \times \text{region}$$

where G ist the effect of the genotype, and

$P$ – the effect of the region.
correlation by the Nr. of spikes/m² and the Mass of grain/spike, and negative by the component Plant height.

**REFERENCES**


Stoyanov H., Baychev V., 2015. Correlations between spike parameters of first generation direct and reciprocal crosses of triticale (x *Triticeaele* Wittm.). Agrarni Nauki, 7(18), 25-34.