SPRING BARLEY VARIETY TRIAL (*HORDEUM VULGARE* L.) IN THE CLIMATIC CONDITIONS OF WESTERN SLOVAKIA

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***Abstract*:** *Spring barley belong to the important cereals in Slovakia, resulting mainly from the fact that Slovakia has in Europe after Germany, France and the Czech Republic the most suitable conditions for growing. The field trial was carried out over the period 2011 - 2012 on the experimental base of the Central Controlling and Testing Institute in Agriculture at Testing station Veľké Ripňany. Yield potential of eight genotypes of spring barley was tested after two forecrop (sugar beet and spring barley) on moderate brown soil with clayey loam subsoil. The evaluated year created very different agro climatic condition for spring barley in Slovakia. Warmer but very dry condition in 2012 mainly during Mai and June created very unfavourable condition for yield expression of evaluated genotypes. Average yield of all evaluated genotypes was significantly higher in 2011 (7.51 t ha^{-1}) with comparison to 2012 (4.247 t ha^{-1}). The all evaluated factor significantly influence the variability of yield in order of importance: year conditions, forecrop, and genotype. Interaction of forecrop with year condition contributed significantly to the overall variability of yield. Better forecrop value of spring barley with comparison to sugar beet was confirmed in both evaluated year. Even in favourable year 2011, yield of spring barley growing after sugar beet has been significantly reduced by 0.84 t ha^{-1}. The environmental conditions in 2011 - 2012, accounted for 58.5% of the total variability and different forecrop value participated with 20.5% of total variability of grain yield. On the average yield of grain, the tested varieties were divided into two groups. The varieties Danielle, Salome and Calcule reached significantly higher yield of grain in both very different year conditions of 2011 - 2012 in range of 6.39 - 6.66 t ha^{-1}. The second group of evaluated varieties Slaven, Signora, Wiebke and Petrus also revealed very high yield potential in narrow range of 6.05 - 6.08 t ha^{-1}. All evaluated varieties are very adaptable on Slovak agricultural condition and also are disseminated to the agricultural praxis.*

***Key words*:** *cultivars, forecrop, spring barley, yield*

INTRODUCTION

Spring barley yield and quality of predictions are of major interest to the growers in order to allow effective crop management (KŘEN et al., 2014). Spring barley and barley products belong to the important products in Slovakia, resulting mainly from the fact that Slovakia has in Europe after Germany, France and the Czech Republic the most suitable conditions for growing.

The creation of crops yield can be defined as the interaction effect soil and climatic conditions, genotype and complex technology of cultivation (ČERNÝ et al., 2015).

Crop rotation is one of the major agro-technical measures to ensure the production of crops. Very good previous crop for spring barley are roots crop fertilized with farm yard manure (sugar beet, potatoes, maize). Medium suitable for cropping barley are legumes-grain mixes, rye, or winter wheat (POSPIŠIL et al., 2012).

MATERIAL AND METHODS

The experiment was based on the plots of the Central Controlling and Testing Institute in Agriculture - the main varietal trial in Veľké Ripňany at south-western part of Slovakia in 2011-2012. The area is located in sugar beet production area. Soil type is brown soil moderate loam to loamy subsoil, topsoil depth is 0.60 meters.

The aim of the experiment was to observe the yield of spring barley grown after sugar beet and spring barley as a forecrop. The eight tested cultivars of spring barely (*Hordeum vulgare* L.) were as follows: Calcule, Danielle, Petrus, Salome, Signora, Slaven, Shuffle, Wiebke.

The experiment was set up as a block plot design with four replications. The eight cultivars on 128 plots were evaluated. Harvested area was 10 m^2. Agro-technical measures were applied under unified methodology for varietal trials in Slovakia.

After sugar beet, deep ploughing in autumn and settlement of soil in spring time followed by mineral fertilization with seed bed preparation was used. After sowing harrow were used.

After spring barley forecrop soil was processed by disc plow with partial incorporation of crop residues followed by medium mouldboard ploughing. During November deep mouldboard ploughing was applied each year. On the spring the soil was settled and mineral fertilizer was incorporated by soil compactor. During 2012 the field after sowing was harrowed and rolled.

For statistical evaluation the statistical software Statistica version 10.0 MR1 was used. Before using multifactorial ANOVA, the data were subjected to homogeneity by using Hartley, Cochran a Bartlett tests.

RESULTS AND DISCUSSION

The air temperature in 2011 followed the standard values of climatological normal, except for April in which the average temperature increased by +2.6°C and July, was lower by -1°C below normal. Rainfall during the growing season have been mostly above the climatological normal standard. April was the driest (-18mm) and June the wettest (+30.4mm) with comparison to climatological normal (tab. 1).

Table 1

Temperature, precipitation and normal climatological rainfall distribution at Veľké Ripňany locality, 2011-2012

Month	Veľké Ripňany 2011		Veľké Ripňany 2012		Climatological normal	
	temperature	precipitation	temperature	precipitation	temperature	precipitation
March	5.8	23,9	7.0	5.9	4.2	31
April	12.7	23	11.5	17.0	10.1	41
Mai	15.6	55.2	17.4	15.9	15.2	55
June	19.3	100.4	20.3	41.3	18.4	70
July	19.3	104.9	22.4	104.2	20.3	77

The year 2012 can be characterized as warm, with higher average temperatures above climatological normal from +1.4°C in April to +2.8°C in March.

Throughout the growing season, outside of July in which rainfall reached +27.2mm above the climatological normal, the condition was substantially dry. The driest month was May with a deficit of 39.1mm under climatological normal.

Crop yields and quality of crops is influenced by rainfall and temperatures not only in terms of quantity but especially by distribution pattern during the vegetation period (KOVÁČ et al., 2005).

Based on the results of multifactor ANOVA it can be stated that in the monitored period 2011-2012 the yield of barley genotypes depends on all the evaluated factors in order of importance: year conditions, forecrop and cultivar (tab. 2).

Table 2

Analysis of variance of factors influencing spring barley grain yield at locality Veľké Ripňany in the years 2011-2012

Factor	Sum of squares	df	Mean squares	F - ratio	P - value
Cultivar	5.78	7	0.83	4.88	0.000149
Forecrop	95.01	1	95.01	561.11	0.000000
Year	217.78	1	217.78	1286.11	0.000000
Cultivar x Year	3.88	7	0.56	3.28	0.004404
Forecrop x Year	24.99	1	24.99	147.60	0.000000
Residual	12.36	73	0.17	-	-

The factors significantly influenced the variability of spring barley genotypes with the highest share of year condition and forecrop. Grain yield was significantly affected particularly by the year (seasonal weather conditions).

Interaction of forecrop with year conditions also contributed significantly to the variability of yields. Main source of variability of yield were year condition and forecrop value.

In the years 2011-2012, environmental conditions contributed to the overall variability, expressed as of sum of squares by 58.5% and forecrop by 25.5%. Due to the balanced set of promising cultivars tested in official variety trial, variability of yield influenced by cultivars was relatively low. The share of forecrop interaction with the conditions of the year was 7 times higher than that of the interaction of variety and year for a total amount of 372.13 square

The share of forecrop on the variability of barley yield at the level of 25.5% demonstrates the importance of selecting the appropriate forecrop. CHMIELEWSKI et al. (1999) attributed to weather conditions up to 60% of the variability of yields of spring barley. Similarly MACÁK et al. (2008), in the evaluation of the components of variation, found 62.4% of the total variability of grain yield of barely influenced by weather conditions growing in organic and low-input system.

Based on the differences of the average yield, varieties were divided into two groups. Significantly less yield reached varieties Slaven, Signora, Wiebke and Petrus.
The average yield of the first group was in a very narrow range 6.051 - 6.087 t ha^{-1} (tab. 3).

Table 3

Yield of spring barley cultivars at Veľké Ripňany locality, 2011-2012

Cultivar	Average yield t ha^{-1}
Slaven	6.051250a
Signora	6.063125a
Wiebke	6.068125a
Petrus	6.086875a
Shuffle	6.180000ab
Danielle	6.393750bc
Salome	6.443750bc
Calcule	6.655625c

The mean marked by the same letter do not differ significantly at P<0.5 probability level

Varieties Danielle, Salome and Calcule achieved significantly higher yield in interval from 6.39 t ha^{-1} to 6.66 t ha^{-1}.

Growing barley after a suitable previous crop is an important eco-stabilizing factor (ULRICH, 2011). VÁŇOVÁ et al. (2005) obtained the most stable quality parameters after sugar beet as a forecrop.

The most sensitive response to the forecrop suitability expressed variety Salome in the agro climatic conditions of the 2011. Variety Salome growing after spring barley achieve higher yields by 1.27 t ha^{-1} as compared to the yield achieved after the sugar beet.

In the unfavourable year conditions of 2012, were even more expressed differences in the forecrop value, to which most responded varieties Shuffle, Wiebke, Salome reducing the harvest of 2.9 t ha^{-1} to 3.77 t ha^{-1}.

Total grain production expressed as summary production of 8 varieties (sum of yield per hectare) is a good indicator of forecrop value. The average annual grain production of evaluated varieties was 48.94 tons during 2011-2012. The total production of grain of spring barley increased by 6.31 tons after better forecrop in 2011. In the unfavourable year 2012, the total grain production of 8 varieties was higher by17.26 tons after spring barley forecrop compared with sugar beet forecrop.

CONCLUSIONS

On the base of the two years results of eight prospective spring barley varieties was confirmed that year condition, forecrop, and genotype significantly influence the variability of yield. Interaction of forecrop with year condition contributed significantly to the overall variability of yield of spring barley. Better forecrop value of spring barley with comparison to sugar beet was confirmed in both evaluated year. Average yield of observed genotypes was significantly higher in 2011 (7.51 t ha^{-1}) compared to 2012 (4.247 t ha^{-1}). The best yield potential confirmed Danielle and Salome in both study years. The yield stability of evaluated genotypes was reflected in unfavourable weather year condition in range of 0.965 t ha^{-1} in 2012. In good growing conditions of the year 2011, the yield differences of average yield was in range of 1.14 t ha^{-1}.

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