YIELD AND TECHNOLOGICAL QUALITY OF SPRING BARLEY GRAIN DEPENDING ON YEAR AND SELECTED CULTIVATION FACTORS

Molnárová Juliana

Slovenská poľnohospodárska univerzita v Nitre,Slovakia

Abstract

Impact of foliar nutrition and growth stimulator on the amount and quality of the spring barley grain yield we monitored in the years 2011 to 2013 in a warm corn production area of Slovakia, for two varieties and five variants of treatment. Among the monitored years was the difference in yield statistically highly significant (p> 0.99) and in average for the whole experiment it reached 4.2 t ha-1, respectively. 2.8 t ha-1. By an influence of vegetation treatment the most significant yield increase in comparison with untreated control was noted at the increased dose of N (80 kg ha-1) in combination with foliar fertilizer Zincuran SC and growth stimulator Sungreen (var.e) 1.2 t ha-1. On the crude protein content and extract a year and a variety had highly significant impact (p> 0.99). From the monitored varieties more qualitative yields were given/provided by the variety Marthe, which in rainfall favorable years (2011 and 2013) reached 10.5%, and 12.0% of crude protein content and 79.8% and 82% of extract. Variety Claire in two years didn't reach the set parameters of crude protein content (9.4%, respectively. 14.4%). Crop treatment in average for three years did not result in statistically significant differences in the content of crude protein and extract.

Key words: foliar nutrition, growth stimulator, yield, crude protein, extract, spring barley

INTRODUCTION

Spring barley is an important densely sowned cereal of temperate zone, where in terms of its yield stability and achievement of good grain technological quality, high importance have weather conditions, especially the uniformity of rainfall distribution at critical times/periods of úrodotvorných elements formation during the growing season. Results of analyzes of rainfall in April and May (2005-2009) confirmed the compliance, production process theories, according to which the vegetative period of barley with increased moisture requirements is a prerequisite of optimal future yield. As optimal in April and May can be considered rainfall totals from 85 to 120 mm (Molnarova, Cimo, et al.2010). The mentioned fact suggests that the variability of the yield, respectively. its decline largely depends on when weather anomalies affect Barley crops. According to several authors, with an impact of climate change there is a decline in yields while increasing their variability (Olesen, Bindi 2002, Špánik 2008). Negative impact of bad year can be partly corrected with some extentlly scientifically controlled diet based on the plant analysis, using of which, where in addition to N we straighten the deficit of other micro and macro elements (Molnarova, 2004, Kovacik, 2010). Kunzová, Šrek (2010) on the non-fertilized controlled variants reached depending on the year of 32.2 to 55.2% decline in yield. On the fertilized variants a decline in yield was 23.8 to 44.0%. Importance of folic nutrition highlight several works of domestic and foreign authors (Varga - Filova, 2004, Molnarova-Jakubec, 2005, Vaněk, et al., 2007 and others). In terms of yield formation authors attach great importance also to the treatment of crops with growth stimulators, which should ensure a settlement of tillers, elimination of non-productive tillers, an increased resistance to lodging, an increased yield and quality production (Krovaček , Černy 2007, Vašák, 2013). Chloupek (2005) in his experiments/trials didnt find a clear impact of growth regulators on the amount and quality of barley grain yield.

Grain quality has a very important influence on the suitability of the barley grain sample for malting industry. By Owens (2002) the physical condition of the grain and the nitrogen content in the grain are generally considered as important indicators of malting potential. Protein content in dry matter is between 8-13%. From the malting point of view optimal is a content from 9.5 to 10.8%. Soltysova and Danilovic (2005) found for malting barleys an increase of the NL content in dry years in which a smooth transition of NL to the grain is undermined. Muchova (2007) indicate that a high content of crude protein means a reduced starch and extract content.

The main objective of the study was to assess the influence of the year and selected factors of cultivation technology on yield and chemical indicators of spring barley grain technological quality.

MATERIALS AND METHODS

In years 2011- 2013 we monitored the influence of the year, foliar nutrition Zincuran SC and growth stimulator Sunagreen on height and selected chemical indicators of spring barley grain yield technological quality. The research task was solved within field polyfactorial trials established at EXBA FAFR SUA in Nitra, on moderate heavy brown soil, moderately stocked with P and well-stocked with K, with humus content 2.16 to 2.23% and soil pH from 5.29 to 5.7 . Average annual rainfall according to the 30-year climate normal (1960-1990) is 532.5 mm and the average temperature is 9.8 ° C. Experiments were established after sugar beet with two varieties of spring barley (Claire and Marthe), at five variants the treatments of crops with a method of divided blocks, keeping the randomness (Ehrenbergerova, 1995), in triplicate: a = 0 control, b = 60 kg N + 30 kg P + 120 kg K, c = 60 kg N + 30 kg P + 120 kg K + Zincuran SC + Sunagreen, d = 80 kg N + 30 kg P + 120 kg K, e = 80 kg N + 30 kg P + 120 kg K + Zincuran SC + Sunagreen. Foliar fertilizer was applied at the growth stage of full tillering (BBCH 25) at a dose of 1 liter per hectare and the growth stimulator was applied in a growth stage of steblovania (BBCH 32) at a dose of 0.5 l ha-1

Grain yield after harvest was converted to a standard moisture of 14%. Chemical parameters (crude protein content in % and extract in %) were determined at the breeding station Hordeum Sladkovicovo Ltd. The differences between the monitored treatment variants as well as varieties and years were evaluated with multifactor analysis of variance Statistica 8 and evidence was tested using the "Tukey" test.

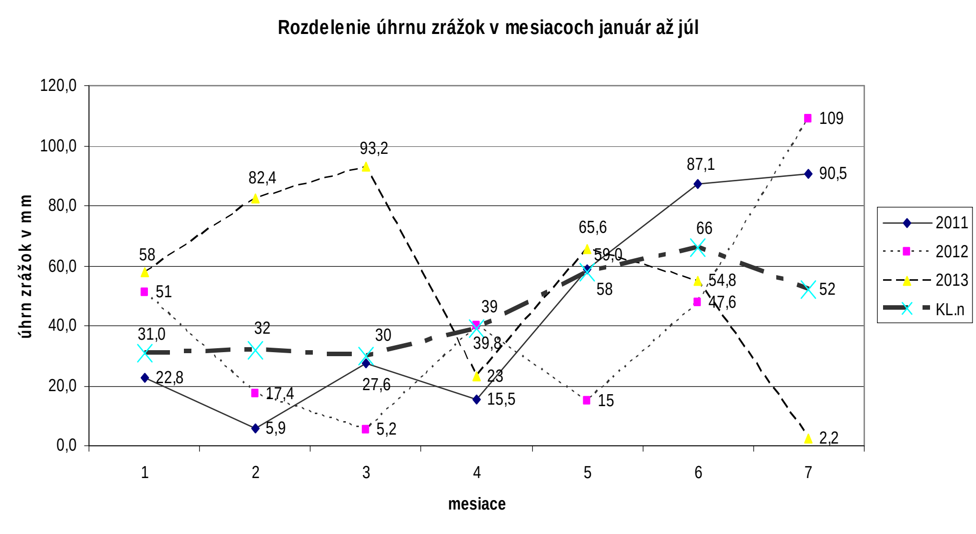

Fig. 1: Monthly rainfall (January-July) in the years 2011 to 2013 on the research base Nitra lower Malanta

RESULTS AND DISSCUSION

Factor year. Progress of weather conditions characterizes the Figure 1. According to total rainfall all the three monitored years can be characterized as normal (with rainfall for the months of January to July 308.4 mm, 285 mm, 379.2 mm), but with a different distribution of rainfall during the vegetation, which was significantly reflected on the amount and quality of the grain yield. The worst distribution of precipitation and temperatures were in 2012, when in the months of February, March and May rainfall reached only 54.38%, 17.33% and 25.42% of climate normal, which had a negative impact on the formation individuals number and tillers, and thus the amount of the grain yield. Another extreme was the year of 2013, when the rainfall in the months of January, February and March amounted 187.1%, 257.5%, respectively. 310.67% of climate normal, thus the sowing date was delayed until April, what for the spring barley in maize production area consideres as a late term. In 2012 in the months of March-July the temperature in comparison with the climate normal was higher by 1.67 to

3.15 ° C, what negatively influenced the grain quality. Among the monitored years the difference in yields was statistically highly significant (p> 0.99) and in average for both varieties it reached 4.2 t ha-1, respectively. 2.8 t ha-1 (Figure 2). The results showed the different varieties response to the late sowing date in 2013. For the variety Claire the differences between the yields achieved in 2012 and 2013 were not statistically significant (0.57 t ha-1), what pointed out the sensitivity of the variety on the later date of sowing. For the variety Marthe the differences in grain yield between the mentioned years were statistically highly significant (p> 0.99) (2.26 t ha-1). The results confirmed our earlier assertion that the variability of yield, respectively. its decline largely depends on when the weather anomalies affect Barley crops (Molnarova, Cimo, et al.2010) .According to Olesen and Bindi (2002) the climate changes of the year cause a decline and greater yields variability of field crops.

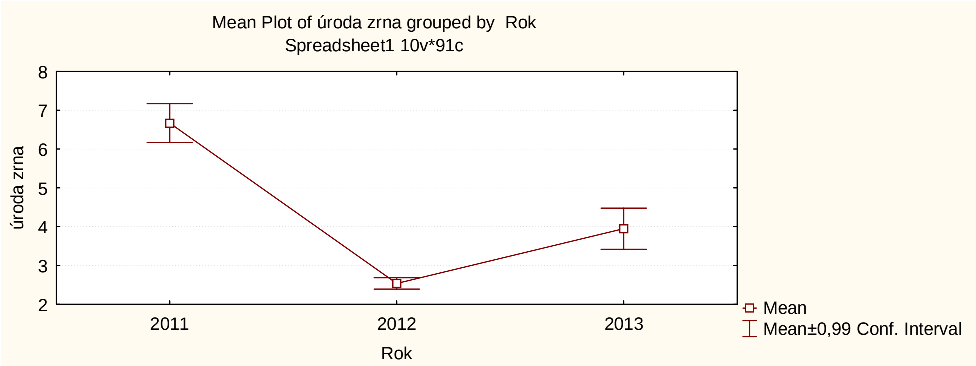

Fig.2: Impact of the year on the grain yield of spring barley in average for the monitored varieties

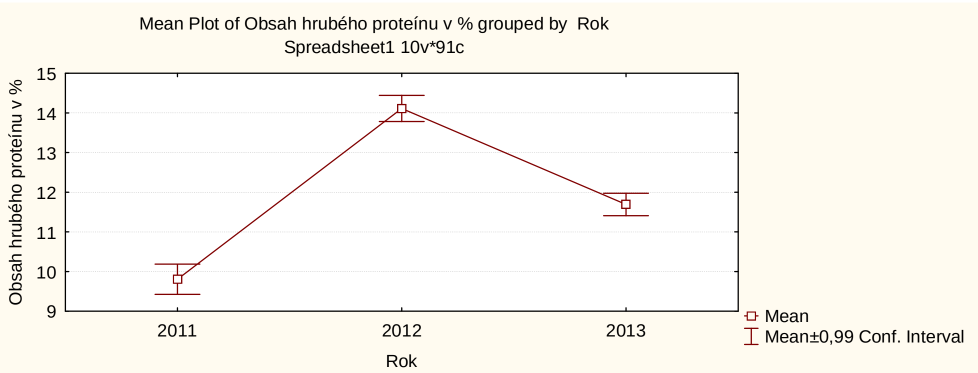

Fig. 3: Impact of the year on the crude protein content in grain yield of spring barley, in average for the monitored varieties

According to Owens (2002) the physical condition of the grain and the nitrogen content in the grain are generally considered as important indicators of its malting potential. Crude protein content (HP) should range from 9.5 to 11.8%, the optimum is 9.5% -10.8% (STN461100-5). The difference between the years in average for the monitored varieties was highly significant (p> 0.99) (fig.3). Highly significantly the lowest content of HP was recorded in 2011. Varieties responded differently to the weather conditions of the year. Significant decrease of crude protein reached the variety Claire, which in average of all treatment variants didnt reach the 9.5% content, thus did not meet the standard criteria. As opposed to Claire, the variety Marthe met the requirements of qualitative malting barley with an average content of HP 10.33%. In terms of grain quality extremely unfavorable was the warm year 2012 Both monitored varieties exceeded by STN461100-5 set up upper limit and reached 14.4% (Claire), respectively. 13.83% (Marthe) according to which the both varieties were excluded from the malting barley group. Similarly, Savin et al. (1997) and Soltysova and Danilovic (2005) found out in malting barleys an increase of NL content in dry years in which the smooth transition of NL to grain is disrupted.

To assess the suitability of processing the barley into the malt a very important criterion is the extract content. Muchova (2007) reports that the high crude protein content means a reduced starch and extract content. Extract content in dry matter ranges from 77 to 82%. According to the extract content the varieties responded statistically highly significantly to the year (p> 0.99) (fig.4). In 2011 for both varieties the extract content reached the optimum values, and that in average for the monitored treatment variants 81.37% (Claire), respectively. 81.70% (Marthe). In 2012 the opinion of Muchova (2007) was confirmed, with an increase of crude protein content, the value of extract declined and none of the monitored varieties did not reach by norm set up low limit of 77%. In average for the treatment variants the extract content ranged from 74.45% (Claire) to 75.74% (Marthe).

Factor foliar nutrition and growth stimulator.

With treating the crop with leaf nutrition and growth stimulator, in average of three years, and both varieties was reached the statistically inconclusive increase of yield (0.83, respectively 1.2 t ha-1) in comparison with untreated control. The most significant increase of yield in average for both varieties as well as within varieties we noticed for a variant 'e' (80 kg N + Zincuran Sc + Sunagreen) 1.2 t ha-1 (0.93 t ha-1 Claire, resp. 1.46 t ha-1 Marthe) (fig.9).

Impact of treatment with foliar nutrition and growth stimulator was statistically highly significant (p> 0.99) only in the most favorable year

2011, when in average of both varieties the yield increased by 2.21 t ha-1 in comparison with untreated control (Fig.5). Increase at the individual varieties reached 1.72 t ha^{-1} (Claire), respectively 2.7 t ha-1 (Marthe). Using Sungreen for crop treatment Křovácek, Černý (2007) a Vašák (2013) reached an increase of yield 0.4 resp. 0.7 t.ha-1. These results are consistent with the results of other authors (Varga - Filová, 2004, Ložek, 2006).

Using foliar fertilizers resp. growth stimulator for crop treatment did not result in statistically significant differences in the crude protein and extract content. Similar results concluded also Chloupek (2005), on basis of which he noted that the growth regulators do not have a clear impact on the amount and quality of barley grain yield.

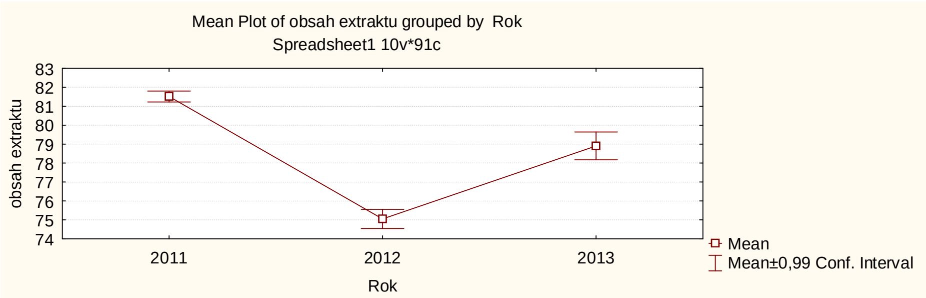

Fig. 4: Impact of the year on the extract content in grain yield of spring barley, in average for the monitored varieties

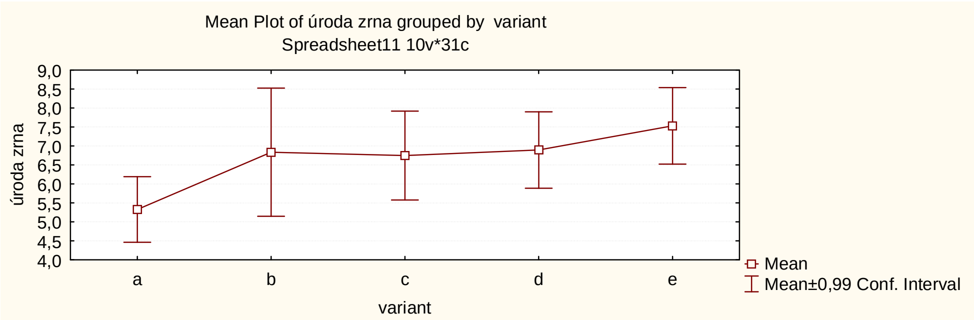

Fig. 5: Impact of crop treatment on the grain yield of spring barley in average for the monitored varieties in 2011

CONCLUSION

From the three years assessment of foliar nutrition and growth stimulator impact on the amount and quality of spring barley grain yield result that their impact is largely influenced by weather conditions of the year during the vegetation and by variety. On the year statistically highly significant (p> 0.99) with an increase of yield responded the variety Marthe (2.26 t ha-1- 4.0 t ha-1) and the variety Claire (4.2 t ha-1) between the years 2011 and 2012-2013. Insignificant differences in yields between the years 2012 and 2013 at the variety Claire pointed out its greater sensitivity to late sowing date due to excessive rainfalls in early spring period 2013. Impact of treatment was statistically highly significant (p> 0.99) only in the most favorable year 2011, when in average for both varieties the yield increased by 2.21 t ha-1 in comparison with an untreated control using an increased dose of N (80 kg ha) in interaction with foliar nutrition and growth stimulator (var.e). In terms of technological quality the varieties responded differently to weather conditions of the year. In the year 2012 the monitored varieties did not meet the standard criteria. The variety Claire met the criteria/requirements of malting barley only in 2013 (with a crude protein content of 11.2% and 81.5% of the extract. The variety Marthe in two years (2011 and 2012) reached 10.5%, and 12.0% of crude protein content and 79.8% and 82% of extract. Using foliar nutrition, respectively. growth stimulator for crop treatment did not result in statistically significant differences in the crude protein and extract content.

Acknowledgments (optional)

The researches were carried out in the project: VEGA 1/0237/11, 1/0359/14.

REFERENCES

1. Ehrenbergerová, J., 1995, Zakladání a hodnocení pokusu. Brno: MZLU,109 s. ISBN 80-7157-153-9.
2. Chloupek O., 2005, Kvalita jačmene. In *Pěstování a kvalita rastlin*, 2005. s. 81. ISBN 80- 7157-897-5.
3. Kováčik P., 2010, Výživa jačmeňa jarného dusíkom, fosforom a draslíkom.:< http://www.agroporadenstvo.sk/rv/obilniny/vyziva_jacjar.htm>.
4. Křováček J., Černý L., 2007, Sunagreen v regulaci růstu jarního ječmene. Kompendium 2007, 29 – 30.
5. Kunzová E. – Šrek P., 2010, Vliv dlouhodobého N, P, K hnojení na výnos ječmene jarního a odběr živin na stanovištích Ivanovice Čáslav a Lukavec v letech 2005-2008. In Pestovateľské technológie a ich význam pre prax. Piešťany : 2010. s. 7-13. ISBN 978-80-89417-24-7.
6. Molnárová, J., 2004, Význam listového hnojiva Campofort fortestim – alfa vo výžive jačmeňa siateho jarného. In Úroda, roč.8, 2004. č. 4, s. 40 – 41, ISSN 1335-2466.
7. Molnárová, J. – Pepó, P.,2010, Sustainable, enniromment friendly field crops production in changing climate conditions. Nitra, 2010 : SPU. 191 p. ISBN 978-80-552-0515-1.
8. Molnárová, J. – Čimo, J. – Špánik, F., 2010, The agroclimatical analysis of production process of spring barley. Universitaţii din Oradea. vol. 9,2010, p. 639-661. ISSN 1583-4301.
9. Muchová Z., 2007, Hodnotenie surovín a potravín rastlinného pôvodu. Nitra: SPU, 2007. s. 215. ISBN 978-80-8069-835-5.
10. Olesen J.E.- Bindi M., 2002, Consequences of climate change for European agricultural

productivity, land use and policy. European Journal of Agronomy. Vol. 16, Issue 4, 2002, pp.239-262

11. Owens, G., 2002, Cereals processing technology. Oxford, England: Woodhead Publishing, 2002. 238 p. ISBN 978-1-85573-561-3.
12. Šoltýsová a Danilovič,2005, Zmeny úrod a kvalitatívnych parametrov jačmeňa siateho jarného v závislosti od podmienok prostredia. In: Rožnovský, J., Litschmann, T. (ed): „Bioklimatologi současnosti a budoucnosti“, Křtiny. 2005. ISBN 80-86 690–31-08.
13. ŠPÁNIK, F., 2008, Klimatické zmeny a ich vplyv na poľnohospodárstvo. (In Líška a i. Všeobecná rastlinná výroba), 2008, s. 65-69, ISBN 978-80-552-0016-3
14. Vaněk, V – Balík, J. – Pavlíková, D. – Tlustoš, P.,2007, Výživa polních a zahradních plodin. Praha : Profi Press, 2007, 176 s. ISBN 976-80-86726-25-0.
15. Varga, L. – Filová. A., 2004, Foliárna výživa poľnohospodárskych rastlín. <http://www.nasepole.sk/pole04/clanok.asp?ArticleID=23>
16. Vašák, J. (2003-2010), 2013, Sunagreen v obilninách.www.chemapagro.sk/clanky-sunagreen-v-obilninach.html