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The influence of selected growing factors on the yield formation and technological quality of barley

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Abstract

The aim of this work was to find out the influence of variety, organic-mineral fertilizer (Condit), and foliar nutrition (Hakofyt extra) on the amount and quality of spring barley grain yield. Attempts were realized in years 2009 to 2011 in Nitra. The following varieties were used-Bojos, Kangoo, Marthe and Xanadu. The highest average yield reached variety Bojos (5.93 t ha^{-1}), with highly significant difference in comparison with Kangoo (4.86 t ha^{-1}) and Xanadum (5.19 t ha^{-1}). Significant influence of Condit was achieved in favorable years. In average grain yield was obtained in an amount of 5.88 t.ha^{-1} which in comparison with the control it meant 18.31% increase. Hakofyt extra + LAV, in a drier year increased the yield in comparison with the control at about 15.25%. From the observed factors the grain quality was statistically significantly affected by varieties.

Key words : spring barley, yield, quality, organic-mineral fertilizer, foliar fertilizer

Introduction

Knowing the requirements of the new biological material on the production technology (such as for example organic-mineral fertilizers, foliar nutrition, etc.) in relation to agro-ecological conditions of the growing environment is the first prerequisite for achieving of stable and high-quality barley harvest. A ratio of the variety on achieved yields is estimated at 25% to 40% depending on the growing conditions of the year (Svorad, 2007). Fundamental changes in the structure of plant production (significant decrease in the areas of sugar beet) as well as a decrease of livestock (demonstrative by a lack of manure) in the Slovak Republic they also cause changes in soil fertility and cause the requirements of changes in nutrition and fertilization of field crops, to which beyond controversy belongs the spring barley. In nutrition and fertilization of this important commodity chances has the use of foliar nutrition and various organo-mineral fertilizers, which is the subject of research of several authors (Obreza et al., 2003; Růžek et al., 2006; Vaněk et al. 2007; Skokanová and Dercová 2008; Kováčik, 2010; Molnarová et al., 2010). The aim of the study was to evaluate the influence of variety, organic-mineral fertilizers and foliar nutrition on the yield and selected indicators of technological quality of spring barley grain.

Material and methods

The field experiments were established in a warm corn production region of Slovakia in years 2009 - 2011 with four varieties of spring barley: Bojos, Kangoo, Marthe, Xanadu, after the sugar beet, with the method of divided blocks, with keeping of randomness (Ehrembergerová, 1995) in three repeating's. We monitored four levels of fertilization: as follows:

a - control: without fertilization,
b - Condit Mineral: in amount of 1 t ha^{-1} before sowing. Ratio of N: P: K = 1:0.063:0.241,
c - 60 kg N (LAV) + 22.7 kg P + 36 kg K + folic nourishment (Hakofyt extra) before sowing: Amofos + KCl 60%,

d - 60 kg N ($NH_4 NO_3$) + 22.7 kg P + 36 kg K + folic nourishment (Hakofyt extra) before sowing: Amofos + KCl 60%.

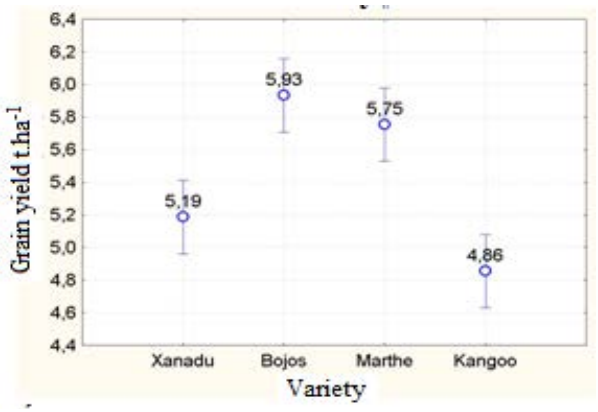
Levels of fertilization c-d: Before fertilization we took soil samples to ascertain the content of Nan (to a depth of 0.60 m), P and K in the soil (to a depth of 0.30 m). N we added to the content of 60 kg per hectare. The amounts of P and K fertilizers were calculated accordingly to the replacement system on the yield level of 7 t ha^{-1}. Foliar fertilizer Hakofyt we applied on the base of leaf analysis at the beginning (BBCH 23) and at the end of tillering (BBCH 25). Condit M (mineral) keeps the soil and allows the natural growth of plants and crops. Condit should be applied only once a year. It is permitted as a fertilizer in organic agriculture. Content of NPK (10% N, 2% P_2O_5, 2% K_2O (http 4). Hakofyt Extra is characterized by higher content of nitrogen (12%). It contains a complete universal nutrition of plants, with an emphasis on natural growth promoters of natural origin in the form of easily accessible to plants. Use of this product has resulted in an increase of yield and assecuration of quality of produced crops.

From the indicators of technological quality we monitored the content of crude protein (HP) and a ratio of the 1st Class grain. To the determination of the individual parameters we collected the biological material from all the levels of fertilization and soil cultivation methods.

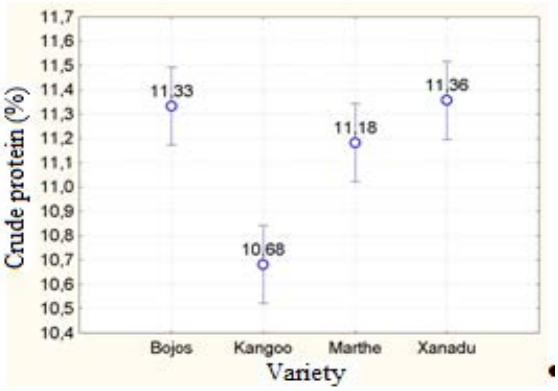
The results were evaluated by multifactor analysis of variance in the program Statistica 8. We verified the evidence using the Tukey test at a significance level of 0.05 and 0.01.

Results and discussion

Variety effects: The highest yield with an influence of variety was achieved in a variety Bojos (5.93 t ha^{-1}). This represents highly significant yield in comparison with the variety Kangoo (4.86 t ha^{-1}) and Xanadu (5.19 t ha^{-1}). Significant difference was observed also between the variety Marthe (5.75 t ha^{-1}) and varieties Xanadu and Kangoo (Figure 1). Slafer et al. (2002) state that the grain yield depends on the genotype and the environment in which the genotype grows. Therefore, in the selection of genotype in term of grain yield it is important to consider a genotype in the interaction with the environment.



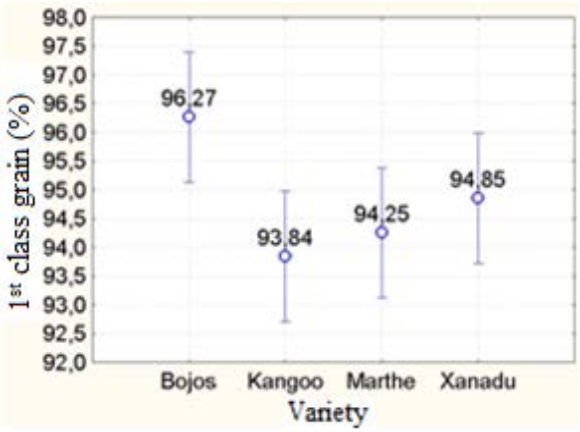
Graph 1. LS averages of grain yield and 99% intervals due to the variety



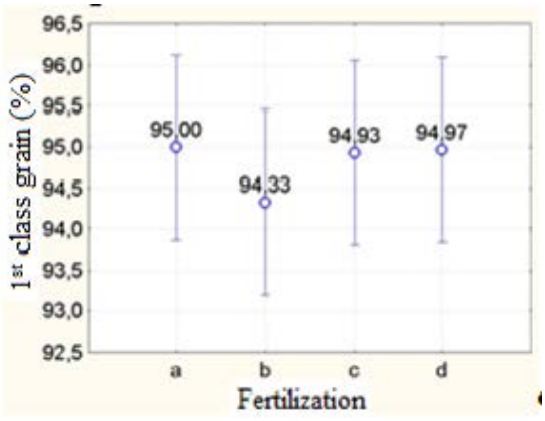
Graph 2. LS averages HP 95% confidence

The Evidence of the variety was confirmed also in the content of crude protein and a ratio of grains of the 1st class (Figure 2, 3) As mentioned the authors De Ruiter and Haslemore (1996), the variability of grain qualitative parameters for the production of malt is mainly caused due to year, differences in production technology and local environmental impacts. In our experiments, the lowest content of HP we found in a variety Kangoo (10.68%). Other studied varieties had significantly higher content of HP (Marthe 11.18%, Bojos 11.33%,

Xanadu 11.36%) (Figure 2). Optimal values of crude protein content by Prugar and Hraška (1989) range from 9.5 to 11.50%. Malting barley should contain 80% of the grains on sieve 2.5 mm (Prugar et al 2008). By us monitored varieties were characterized by a high content of 1st class grains in all years and in average for three years they reached 93.84% (Kangoo) to 96.27% (Bojos). Varieties Xanadu (94.85%), Marthe (94.25%) and Kangoo (93.84%) achieved significantly lower values of 1st class grain ratio in comparison with the variety Bojos (Fig. 3).

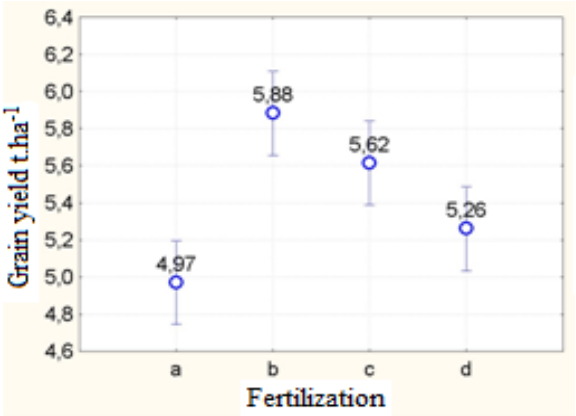


Graph 3. LS averages of 1st class grain ratio and 95% confidence intervals due to the variety

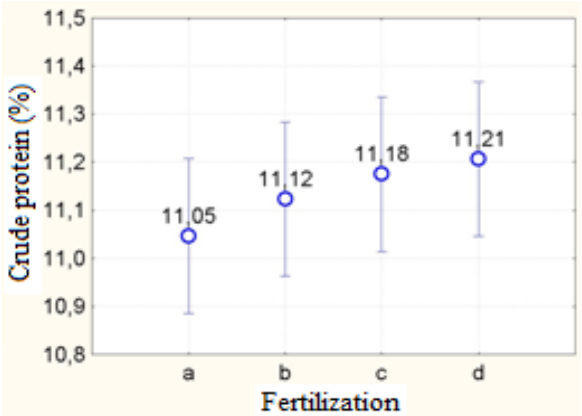


Graph 6. LS averages of 1st class grain ratio and 95% confidence intervals due to fertilization

Nutrition and fertilization effects - fertilization had a high significant influence on grain yield of spring barley. The highest grain yield due to fertilization was achieved for variant b (5.88 t ha^{-1}), which was treated with organic-mineral fertilizer Condit. The lowest grain yield was on the controlled variant (4.97 t ha^{-1}). Significant differences were observed between variants "a" and "b", between variants "a" and "c" (5.62 t ha^{-1}, Hakofyt extra + LAV) (Figure 4).



Graph 4. LS averages of grain yield and 99% confidence intervals due to fertilization



Graph 5. LS averages of crude protein and 95% confidence intervals due to fertilization

Condit fertilizer contains a high percentage of dry matter (minimum 80%). From the monitored years months April and May in the year 2009 were extremely dry, and high content of dry matter of fertilizer even more desiccated the soil, which leaded to slower

growth and development of barley and thus to lower grain yield, in comparison with the variants treated with foliar fertilizers ("c" , "d"). Years 2010 and 2011 were climatelly different from the year 2009. Excessive rainfall helped to stimulate the positive characteristics of this fertilizer and in average in three years, we achieved significantly highest grain yield for the variant "b" (Condit -5.88 t ha^{-1}). In terms of a combination of industrial fertilizers and foliar nutrition we achieved higher grain yield for the variant "c", Hakofyt extra + LAV (Figure 4). In comparison with the control the grain yield increase was statistically significant, it ranged from 11.35% (in 2010) to 15.25% (in 2009). Similar results achieved also Macák et al. (2008) and Kunzová and Šerk (2010).
Fertilization didn't have a significant influence on the content of crude protein (Figure 5). In 2009, we achieved the overflow HP content (12.38%). Significantly lower, qualitatively acceptable content of HP was in 2010 (9.90%) and 2011 (11.14%). To similar results came Savin et al. (1997) and Šoltysová and Danilovič (2005), who in malting barley achieved an increase of NL in the poorest rainfall years when dry weather disrupts a uniform and smooth transition of NL to the grain.
On the ratio of 1st class grain the fertilization didn't have statistically significant influence. The highest values of 1st class grain ratio we achieved on the controlled unfertilized variant (95%) (Figure 6).

Conclusions

From the average three-year evaluation of the impact of organic-mineral fertilizer Condit and foliar fertilizer Hakofyt extra with various combinations of fixed N fertilizers on the yield and selected indicators of technological quality of spring barley grain result the following conclusions:
Achieved results of yields pointed out the importance of choosing the variety. In the three-year average for the whole experiment the highest average yield reached the Bojos variety (5.93 t.ha^{-1}). In comparison with the variety Kangoo (4.86 t ha^{-1}) and Xanadu (5.19 t ha^{-1}) the difference was highly significant. Significant difference was also between a variety Marthe (5.75 t ha^{-1}) and varieties Xanadu and Kangoo.
An Effect of organic-mineral fertilizer Condit was mainly influenced by a continuance of the year weather conditions. A positive, statistically significant influence was achieved in rainfall favorable years, and in average for three years and observed varieties for this variant was achieved the highest grain yield 5.88 t ha^{-1}, what in comparison with untreated control it meant 18.31% increase. In the drier year in terms of harvest advantageous was a combination of leaf fertilizer Hakofyt extra and LAV, when an increase of yield in comparison with an untreated control reached 15.25%. From the observed factors the technological quality of grain- the content of crude protein and a ratio of 1st class grain were statistically significantly influenced by varieties. In average for the observed years the lowest content of HP reached a variety Kangoo (10.68%). Other observed varieties had significantly higher content of HP (Marthe 11.18%, Bojos 11.33%, Xanadu 11.36%). The highest ratio of 1st class grain reached the variety Bojos (96.27%). For other varieties the values of 1st class grain ratio were significantly lower: Xanadu (94.85%), Marthe (94.25%) and Kangoo (93.84).

Acknowledgement

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