Impact of nitrogen topdressing on the quantity and quality of yield of wheat varieties

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Abstract

Impacts of N topdressing applications were studied in a field experiment to determine water availability grain yield and protein formation interrelations. Five winter wheat varieties and six nitrogen application levels were applied in two crop years representing different precipitation and temperature patterns to evaluate yield, yield components and quality manifestation. The results obtained suggest, that precipitation patterns in relation with the wheat development phenophases had profound influence on the grain yield and the protein formation of wheat crop. Varietal differences were determined regarding yield, protein values in relation with plant nutrition and crop year impacts. There were no or minor differences between varieties, however plant nutrition treatments induced significant differences in both crop years.

Keywords: N topdressing, wheat, grain yield, protein yield, crop year

Összefoglalás

A nitrogén fejtrágyázás, a csapadék és a hőmérséklet szemtermésre és fehérje produkcióra gyakorolt hatását vizsgáltuk öt őszi búza fajtán hat N szinten két egymást követő, eltérő csapadék eloszlású és hőmérsékletű évjáratban. Vizsgáltuk a kísérleti tényezők termésre, terméselemekre és a minőségre gyakorolt hatását. A kapott eredmények alapján megállapítható volt, hogy a csapadék mennyisége és megoszlása, összefüggésben a búza fejlődési fenofázisaival meghatározó volt a fajták termésére és fehérje produkciójára. A vizsgált fajták között nem, vagy csak kismértékű, a tápanyagellátási kezelések között azonban szignifikáns különbségek voltak mindkét vizsgált évjáratban.

Kulcsszavak: N fejtrágyázás, búza, szemtermés, fehérje termés, évjárat

Introduction

Grain yield and yield quality of winter wheat *Triticum aestivum* L. is highly influenced by the meteorological conditions of the given crop year, especially the amount and distribution of precipitation and the actual temperature (Győri 2008, Pepó 2010). Weather conditions are evaluated and labelled favourable or non-favourable in relation with the optimum requirements of the crops' phenophases (Ványiné and Nagy 2012). Concerning precipitation, the most vulnerable periods during growth and development of winter wheat are the phenophases of heading and flowering. In relation with temperature, two critical periods can be detected. One is the vernalisation, and the other is the ripening stage (Kismányoky and Ragasits 2003). Crop yield and grain quality can also be influenced by agronomic applications. Plant nutrition in general and N topdressing in particular should be considered as the most effective treatments within the technologies of winter wheat production. The amount of nitrogen and the timing and distribution of the application have an impact on wheat quality, especially on the protein production of the crop (Győri 2006. Pepó 2010).

Material and method

A wide range of high milling and baking quality winter wheat *Triticum aestivum* L. varieties were examined under identical agronomic conditions in a long term field trial. The small plot trials were run at the Nagygombos experimental field of the Szent István University, Crop Production Institute, Hungary. Soil type of the experimental field is chernozem (calciustoll). The experiments were conducted in a split-plot design with four replications. The size of each plot was 10 m^2. Plots were sown and harvested by plot machines (standard Wintersteiger cereal specific experimental plot machinery series). Various identical agronomic treatments were applied to plots. N topdressing variants were applied by single and repeated topdressings representing 6 levels: 0, 80, 80+40, 120, 120+40 and 160 kg/ha N in single and split applications. All plots were sown with identical series of wheat varieties for studying their performance in relation with agronomic impacts. The recent study presents the performance and evaluations of six winter wheat varieties (Alföld-90, Mv Magdaléna, Mv Suba, Mv Toborzó and Mv Toldi) of the 2013 and 2014 crop years. Wheat grain quality parameters: protein, and wet gluten contents were determined from grain samples, as well as quality characteristics at the Research

Laboratory of the SIU Crop Production Institute, and RET Regional Knowledge Centre laboratories according to Hungarian and EU standards (MSZ 1998; EK 2000). The protein figures were correlated with the treatments applied, and analyses were done by Microsoft Office 2003 statistical programmes (Horváth 2014). Phenological phases have been evaluated in accordance with the monthly precipitation and temperature figures of the respective crop years by the methods of Kismányoky and Ragasits (2003).

Results and discussion

Yield results of the trial are summarized in Figure 1 and 2. The total amount of grain yield (kg/ha) is indicated for the two respective crops years for all the wheat varieties examined. The results obtained suggest, that the two crop years examined had different levels of grain yield regardless to varieties. In 2013 grain yield amounts ranged from 2,9 to 7,5 t/ha with definite differences between N applications, while in 2014 this turned to be 4,8 to 7,3 showing less variations between plant nutrition treatments. In both crop years minor varietal differences were detected only.

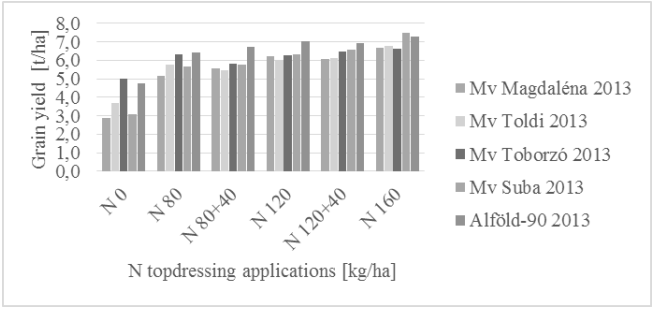

Figure 1. Total grain yields in favourable crop year. Nagygombos 2013

Quality information is provided by in Figure 3 and 4. The total amount of protein yield (kg/ha) is indicated for the two respective crops years by all the wheat varieties examined. The results obtained highlight three factors.

The first of them is the difference between the amounts of protein yield. In 2013 the range of total amount of protein was between 412 and 1187 kg/ha. In 2014, a non favourable crop year resulted in 513 and 988 kg/ha protein yield values.

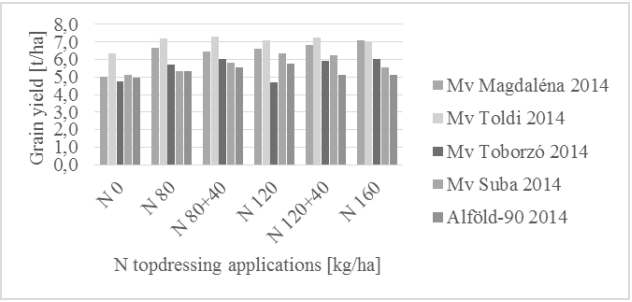

Figure 2. Total grain yields in non-favourable crop year. Nagygombos 2014

The second is the consequent differences between the impacts of N application levels. These differences were significantly bigger in the favourable crop year in comparison with those of the non-favourable vintage. The reason of such deviation was due to the amount of precipitation during the phenophases of flowering and grain filling of the respective crop years. The third factor detected was the performance of varieties. From among the five varieties examined three cultivars – Mv Suba, Mv Toborzó and Mv Toldi proved to be the most efficient regarding the amount of total protein yield production. The highest protein yields were obtained by Mv Toborzó in 2013, while in 2014 the Mv Toldi cultivar produced superior figures.

The results obtained suggest that strong correlation was detected between the total amount of protein and the experimental treatments, regardless to the impact of crop years' weather in accordance with the findings of Győri (2008) and Pepó (2010). Yield figures of the cultivars were in close correlation with plant nutrition with a few exceptions only. However this correlation proved to be stronger and at the same time more balanced in the favourable crop year.

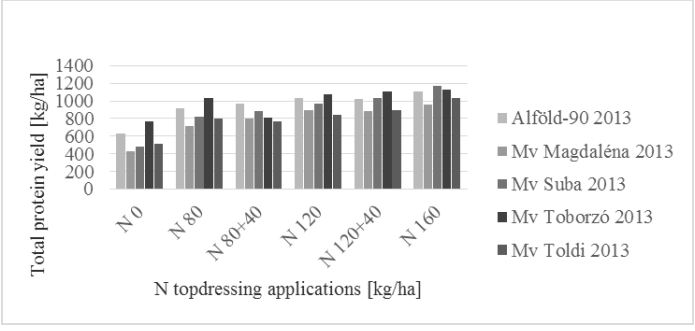

Figure 3. Total protein yields in the favourable crop year. Nagygombos 2013

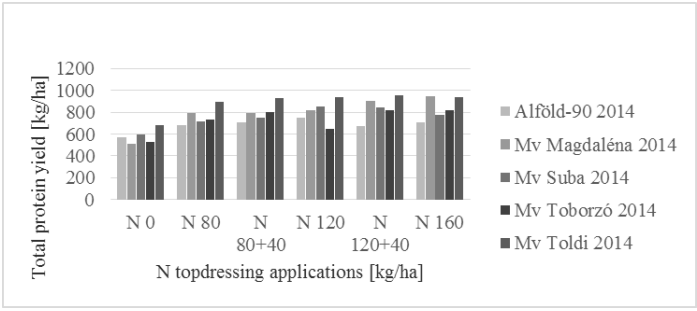

Figure 4. Total protein yields in non-favourable crop year. Nagygombos 2014

The correlations of crop yield components were much weaker in both crop years in comparison with those of yield and protein values. The most vulnerable phenological periods of winter wheat were the stages of heading and flowering in relation with precipitation and vernalisation and ripening concerning temperature performance in accordance with the results of Kismányoky and Ragasits (2003).

Acknowledgement

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