

## IMPACT OF NITROGEN TOPDRESSING ON THE PERFORMANCE OF WHEAT YIELD AND GRAIN PROTEIN

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**Abstract:** Yield samples of winter wheat *Triticum aestivum* L. varieties taken from the Nagyombos experimental site of the Szent István University in two different crop years have been evaluated. Impact of N topdressing on the performance of yield and protein was studied. In case of five high quality wheat varieties yield and protein values were examined. The results suggest that ascending doses of N topdressing, and split applications had a beneficial effect on the yield figures, the amount of protein content as well as the total protein yield of the wheat varieties examined.

**Keywords:** yield, grain protein, total protein yield, winter wheat

### Introduction

Wheat is the most widely spread basic staple for mankind. Wheat is also one of the most important cereals in Hungary with a high economic value. Utility, market and alimentation value of this crop is highly affected by agri-environmental conditions and within that crop year effects, as well as agronomic impacts (Győri 2006; Várallyay 2008). The aim of wheat production is twofold; to provide quantity and quality. Milling and baking quality of wheat is mainly determined by the genetic basis however it can be influenced by management techniques (Grimwade et al 1996; Pollhamerné, 1981; Pepó 2010; Vida et al. 1996).

The protein content of the wheat crop may have important impacts on the nutritional quality for humans and livestock and on the functional properties in food processing. The amount of wheat yield, as well as the grain quality is highly influenced by the nitrogen supply of the crop. Nowadays yield levels of wheat production exceed five to ten times that of the natural yielding ability of this grain crop. Unless mankind would risk the deterioration of nutrient supply of arable land, fertilization has to be implemented in favour of maintaining nutrient balance of the field and to avoid exploitation (Hegedűs et al. 2002).

Also, the means and the way of fertilization in general and N supply in particular may induce changes in wheat quality. The protein content of the grain is responsible for both bread-making quality and the value of animal feed. (Lásztity 1999; Shewry and Halford 2001, Kismányoky and Ragasits 2003; Győri 2008). Long term trials have proved that ascending doses of N applications resulted in dry matter and quality improvement of wheat varieties (Berecz and Ragasits 1990; Ragasits et al 2000).

The present study is dealing with the impact of nitrogen supply on the performance of yield and protein content of wheat grain in the case of different varieties.

### Materials and methods

In a long term field trial a wide range of high milling and baking quality winter wheat *Triticum aestivum* L. varieties were examined under identical agronomic conditions. The small plot trials have been run at the Nagyombos experimental field of the Szent István University, Crop Production Institute, Hungary since 1998. Soil type of the experimental field is chernozem (calciustoll). Annual precipitation of the experimental site belongs to the 550-600 mm belt of the Northern edges of the Hungarian Great Plain.

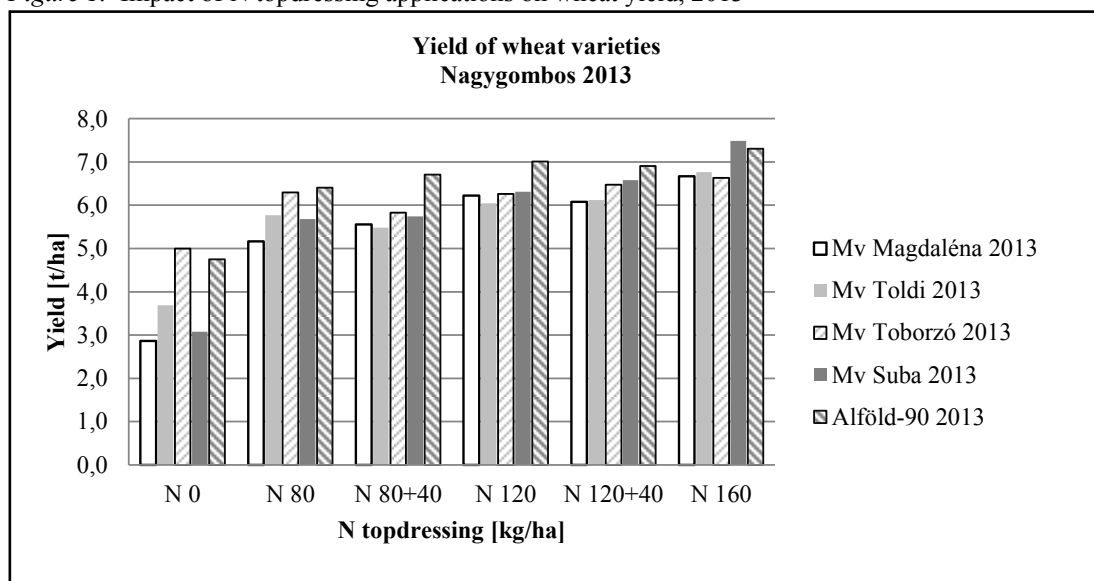
Experiments were conducted in split-plot design with nine replications. The size of each plot was 10 m<sup>2</sup>. Plots were sown and harvested by plot machines (standard Wintersteiger cereal specific experimental plot machinery series). Various identical agronomic treatments were applied to plots. Plant nutrition applications were done in single and combined treatments. N topdressing variants were applied by single and repeated topdressings representing 4 levels: 0, 80, 120 and 160 kg/ha N in single applications, whereas 80+40 kg/ha and 120+40 kg/N in two applications (at the time of tillering and heading). 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 five winter wheat cultivars (Alföld 90, Mv Magdaléna, Mv Suba, Mv Toborzó and Mv Toldi) of two consecutive crop years; 2013 and 2014.

laboratories according to Hungarian standards (MSZ 1998). The protein figures and the total protein yield figures were correlated with the treatments applied. Statistical analyses were done by Microsoft Office 2003 programmes.

### Results and discussion

The results obtained suggest, that ascending doses of N supply resulted in yield increase regarding all varieties and both crop years. The amount of grain yields are shown by figures 1 and 2. There were differences between the yield levels of the two crop years. In 2013 yield figures were detected within the range of 2.9 to 7.4 t/ha. There were varietal differences as well. Untreated control has shown significant differences between varieties. Highest yields were obtained on the plots of Alföld 90 and Mv Toborzó. The highest yields were found in the case of 160 kg/ha topdressing. Mv Suba proved to be the highest yielding variety.

Figure 1. Impact of N topdressing applications on wheat yield, 2013



Wheat yield were measured by each plot harvested. Protein content was determined from grain samples, as well as other quality characteristics at the Research Laboratory of the SIU Crop Production Institute, RET Regional Knowledge Centre and the NÉBIH National Food Chain Safety Office

In the 2014 crop year wheat yields were recorded within a narrower range of 4.8 to 7.3 t/ha. There were also varietal differences. Untreated control has shown minor differences between varieties only. The highest yields were found in the range of 80 to 120+40 kg/ha topdressing applications. In this crop year

Figure 2. Impact of N topdressing application on wheat yield, 2014

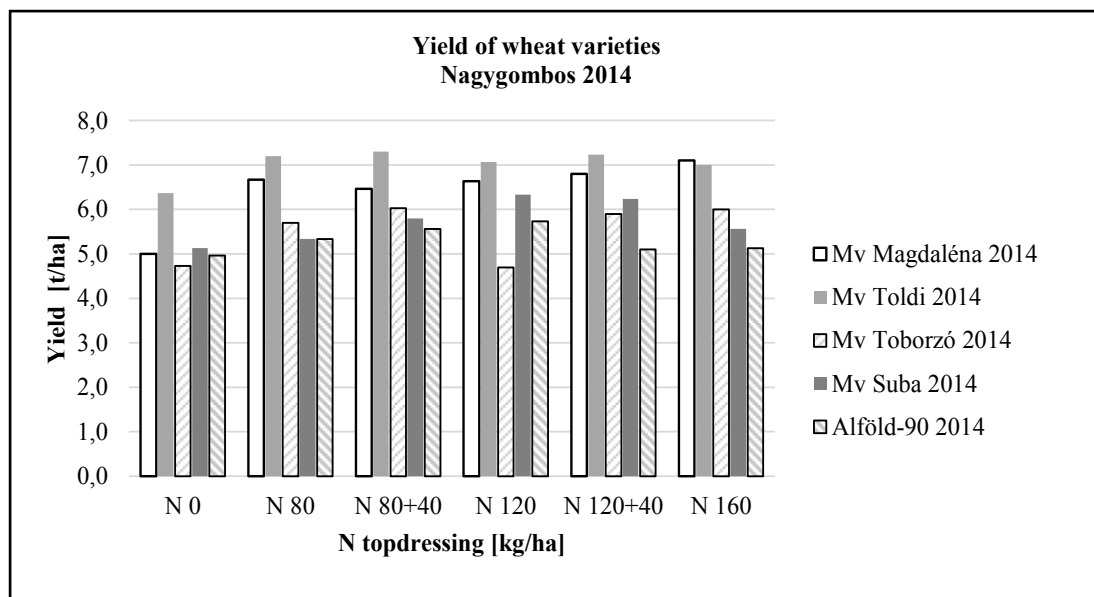
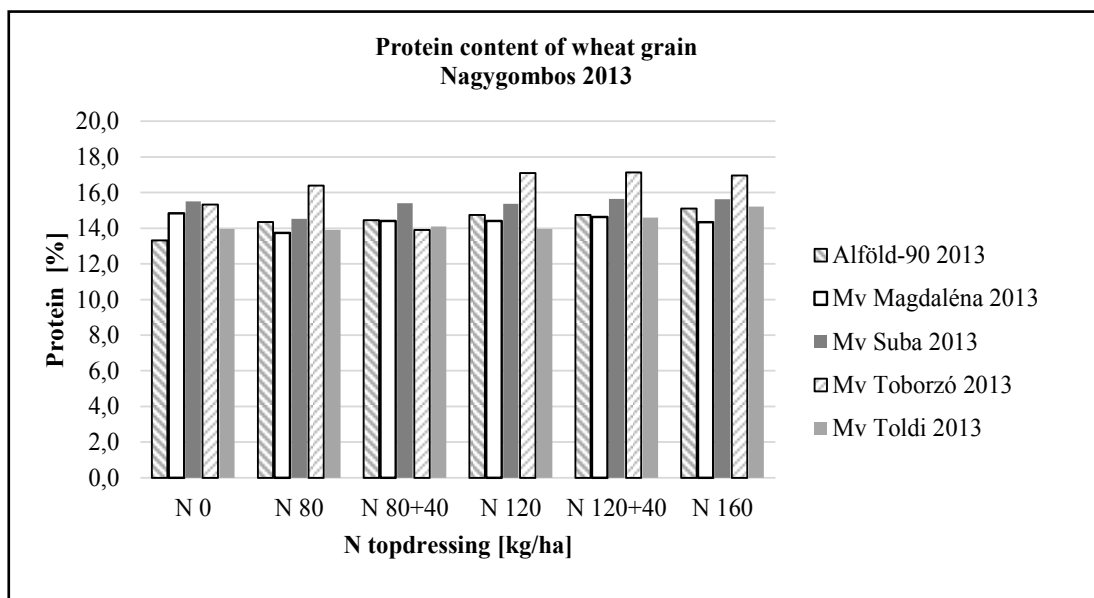


Figure 3. Impact of N topdressing applications on wheat grain protein content, 2013



160 kg/ha doses induced yield decrease in all varieties. Mv Toldi proved to be the highest yielding variety in this year.

Analyzing wheat grain samples protein content proved to be highly affected by N applications as well as varieties examined. There were also significant differences between the protein levels of the two crop years. Figures 3 and 4 comprise data of protein performance in 2013 and 2014.

2013 proved to be a high protein crop year with small, but significant differences between

applications. Protein figures ranged from 13.2 to 17.2 %. The smallest figure was obtained in the untreated control, while the highest was observed in the treatments 120 to 160 kg/ha. Mv Toborzó proved to be the best variety in this crop year along most of the treatments.

2014 can be considered an average crop year concerning protein figures. Protein figures ranged between 10.1 to 14.0 %. The smallest figure was also recorded in the untreated control, while the highest was obtained in the treatments 120 to 160 kg/ha. Mv

Figure 4. Impact of N topdressing applications on wheat grain protein content, 2014

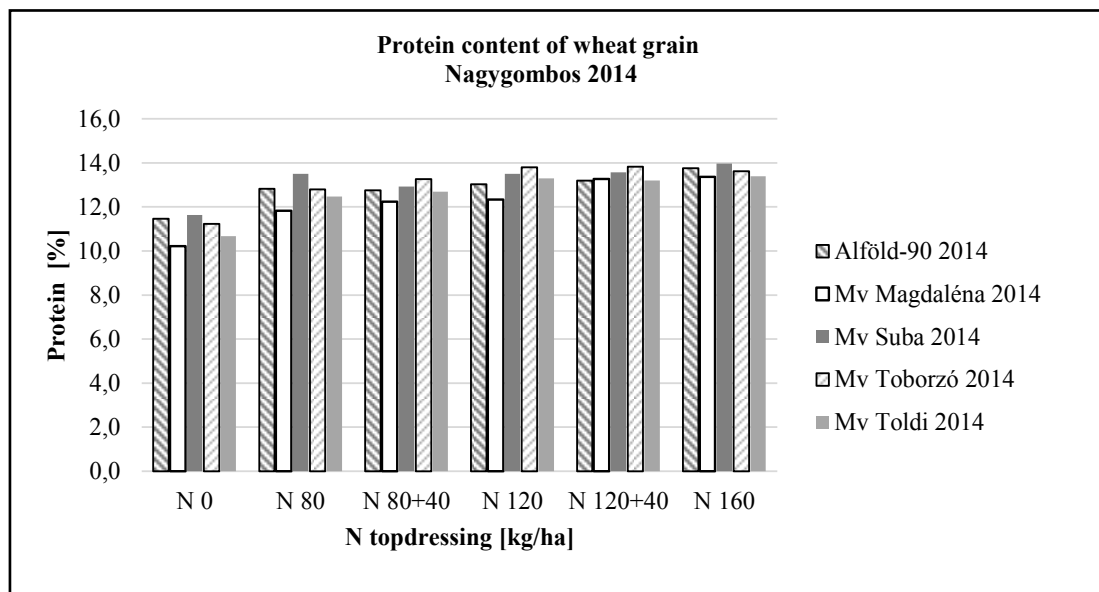
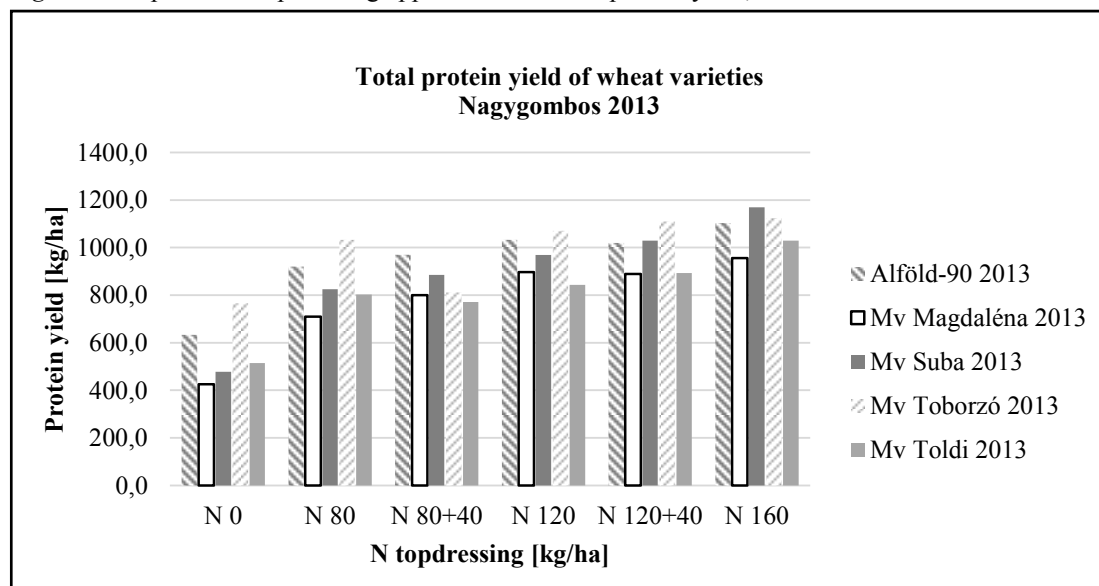


Figure 5. Impact of N topdressing applications on total protein yield, 2013



Toborzó and Mv Suba proved to be the best varieties in this year in most of the treatments.

Figure 5 and 6 give information on the total protein yield of the varieties examined. Yield and quality evaluations of grain crops very seldom make attempts to estimate protein yields, however the amount total protein content of grains exceed the level of that of so called proteinous field crops, like pulses.

Total protein yields were higher in 2013. The amount has been varied by treatments and

varieties within the range of 410 to 1190 kg/ha. In 2014 the range was almost similar but narrower. Protein yields ranged between 515 and 970 kg/ha. Differences between N applications were bigger than that of varieties in both crop years.

Table 1 and 2 presents correlation figures between treatments and varieties concerning yield figures, protein values and protein yield amounts. With a few exception the treatments and the parameters examined have been highly correlated with each other. In 2013 there were

Figure 6. Impact of N topdressing applications on total protein yield, 2014

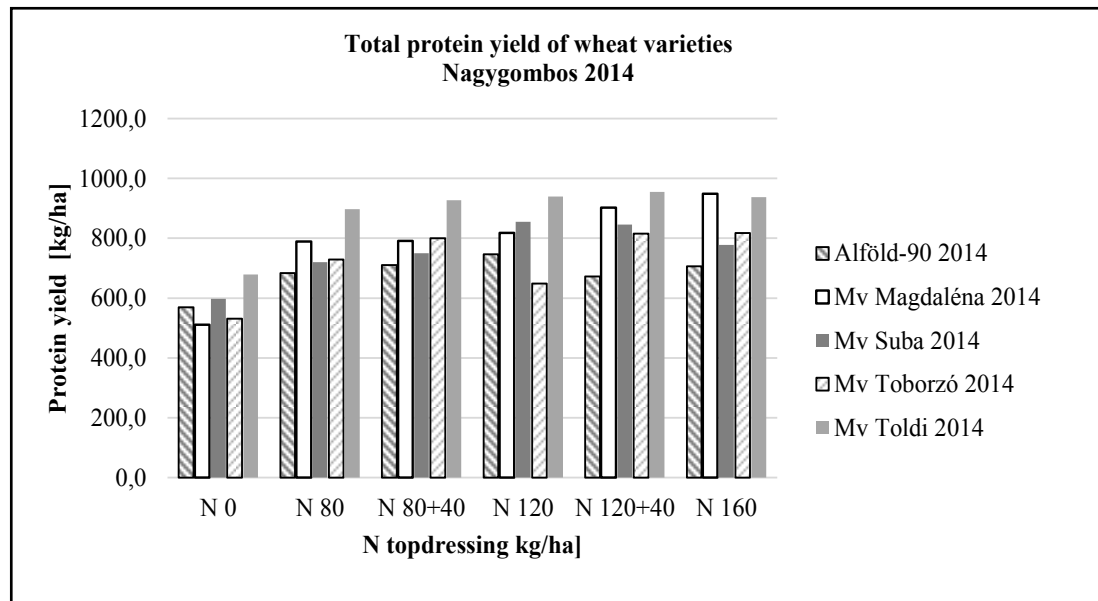


Table 1. Correlation between N topdressing applications and performance of wheat varieties in the 2013 crop year

Wheat varieties	Impact of N doses on		
	Yield, t/ha	Protein content, %	Protein yield kg/ha
r (Alföld-90)	0.9837	0.9962	0.9909
r (Mv Magdaléna)	0.9883	0.4003	0.9901
r (Mv Suba)	0.9936	0.1305	0.9990
r (Mv Toborzó)	0.9452	0.9509	0.9661
r (Mv Toldi)	0.9802	0.6782	0.9863

Table 2. Correlation between N topdressing applications and performance of wheat varieties in the 2014 crop year

Wheat varieties	Impact of N doses on		
	Yield, t/ha	Protein content, %	Protein yield kg/ha
r (Alföld-90)	0.4578	0.9877	0.8826
r (Mv Magdaléna)	0.9463	0.9954	0.9828
r (Mv Suba)	0.5977	0.9463	0.8592
r (Mv Toborzó)	0.5716	0.9536	0.8645
r (Mv Toldi)	0.7506	0.9729	0.9308

two varieties (Mv Magdaléna and Mv Suba), where weak correlations were found only. In 2014 all versions correlations could be detected, however the level of correlations was not so strong in the case of yield performance of some varieties.

both quantity and quality manifestation was influenced by N supply. The recent study was based on the evaluations of five cultivars in two crop years.

### Conclusions

The results of the experiment highlight that

Ascending levels of N topdressing. and

increased number of fertilizer broadcasting applications proved to have a positive effect on the crop yield and on the amount of protein content of winter wheat varieties. The results suggest that ascending doses of N topdressing and split applications had a beneficial effect on the yield figures, the amount of protein content as well as the total protein yield of the wheat varieties examined. There were differences between both the yield and protein figures of the two crop years.

In the study definite differences were found between the performance of the wheat varieties. Mv Suba and Mv Toborzó were found to be the highest protein yielding varieties.

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