IMPACT OF NITROGEN SUPPLY ON RELATIVE DEVELOPMENT OF THREE WINTER WHEAT (*TRITICUM AESTIVUM L.*) VARIETIES

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Abstract. *The aim of our study was to determine the effect of N top dressing on the yield components of three wheat varieties. Our experiments were carried out in Szeged – Öthalom on 10m^2 experimental plots, three winter wheat varieties (GK Békés, GK Csillag, GK Petur), in two growing seasons (2010/2011, 2011/2012), 2 fertilizer treatment per growing season, with 3 repetitions, random block arrangement. The yield components were evaluated by kind of Sváb cumulative yield analysis. The cumulative yield production analysis gives opportunity for graphic representation of plant development, where horizontal axle (x) represents yield components (end products of different development stages) per unit area in developmental order, and vertical axle (y) indicates the percent value of yield components referring to a basis for comparison. In the course of cumulative yield production analysis the followings are considered as yield components: A=number of seeds m^{-2}, B=number of shoots m^{-2}, C=number of ears m^{-2}, D=number of spikelets m^{-2}, E=number of grains m^{-2}, F=grain weight m^{-2}. The examined genotypes have a characteristic development line, the relative positioning of their yield components shows the characteristic features of the variety. GK Csillag is an extraordinarily tillering, number of shoot per unit area, number of ear, number of spikelet and number of grains are favorable. GK Békés and GK Petur are characterized by a larger thousand-seed weight. The plants which didn't get the early spring nitrogen dose, couldn't tiller as the ones received the N treatment in time. The April and May nitrogen surplus is beneficial for the ear number and grain number value of winter wheat. The delayed, higher doses of nitrogen fertilization cannot compensate the backlog of plants, so it is result poor yield. The continuous, issued in several installments N-dose is preferable for winter wheat, so it is result higher yield as a large amount of N applied to a few times.*

Keywords: *winter wheat, nitrogen fertilization, N top dressing, yield component*

INTRODUCTION

One of the most demanding and most responsive cultures of cereal crops for nutrient supply and fertilization is winter wheat (PEPÓ, 1995; SZENTPÉTERY ET AL., 1995). The research on the nutrient treatment of the winter wheat is versatile and extensive in Hungary. MATUZ ET AL (2007), PETRÓCZI ET AL. (2008), TANÁCS (2007) and TANÁCS ET AL. (2006) examined the effects of fertilisers and fungicide treatments on the quality, while JOLÁNKAI ET AL (2006) on the quantity of the crop. The winter wheat requires different levels of nitrogen in different phenophases (JOLÁNKAI 1993), in practice on the other hand, allows one or two doses of nitrogen fertilization.

LÖNHARDNÉ ET AL. (1995) have found that nutrient supply has a decisive influence on the quantity of ears (length of ears, weight of ears, grains number/ears). In contrast, HARMATI (1987) did not attribute most of the increase in fertilizer yields to the quantitative parameters of ears, but to productive tillering tendency (an increase in the number of grains). According to JAKAB ET AL. (2017) the fertilization had different effect on the examined generative factors. The thousand seed weight did not change significantly, but the change of length of spike and number of spiklets under the influence of fertilization was significant. Fertilization had a significant effect on the length of spike, weight of spike and grain number of spike (JAKAB ET AL., 2016). KRISTÓ ET AL. (2008) have found that the PK and the NPK treatments significantly increased the number of shoots, the number of ears, the number of spikelets.

According to LESZNYÁKNÉ (2001), the thousand-seed weight is a genetically strongly defined yield component that can only be slightly influenced by agrotechnical factors.

The aim of our study was to determine the effect of N top dressing on the yield components of three wheat varieties.

MATERIAL AND METHODS

Our experiments were carried out in Szeged – Öthalom on 10m^2 experimental plots, three winter wheat varieties (GK Békés, GK Csillag, GK Petur), in two growing seasons (2010/2011, 2011/2012), with 3 repetitions, random block arrangement. Fertilizer treatments differed at N doses and at the time of application (Table 1).

The yield components were evaluated by kind of Sváb cumulative yield analysis (SVÁB 1961, 1962). The cumulative yield production analysis gives opportunity for graphic representation of plant development, where horizontal axle (x) represents yield components (end products of different development stages) per unit area in developmental order, and vertical axle (y) indicates the percent value of yield components referring to a basis for comparison. In the course of cumulative yield production analysis the followings are considered as yield components: A=number of seeds m^{-2}, B=number of shoots m^{-2}, C=number of ears m^{-2}, D=number of spikelets m^{-2}, E=number of grains m^{-2}, F=grain weight m^{-2}.

Table 1.

Data of fertilizer treatments in the experiment

	2010/2011.				2011/2012.			
number of treatments	date of treatments	N dose (kg ha^{-1})	P_2O_5 dose (kg ha^{-1})	K_2O dose (kg ha^{-1})	date of treatments	N dose (kg ha^{-1})	P_2O_5 dose (kg ha^{-1})	K_2O dose (kg ha^{-1})
fertilizer 1.	06.09.2010.	45	45	45	10.09.2011.	45	45	45
	24.02.2011.	55	0	0	20.02.2012.	50	0	0
	07.04.2011.	27	0	0	19.04.2012	0	0	0
	10.05.2011.	27	0	0	25.05.2012.	0	0	0
fertilizer 2.	06.09.2010.	45	45	45	10.09.2011.	45	45	45
	24.02.2011.	0	0	0	20.02.2012.	50	0	0
	07.04.2011.	100	0	0	19.04.2012.	50	0	0
	10.05.2011.	100	0	0	25.05.2012.	50	0	0

RESULTS AND DISCUSSIONS

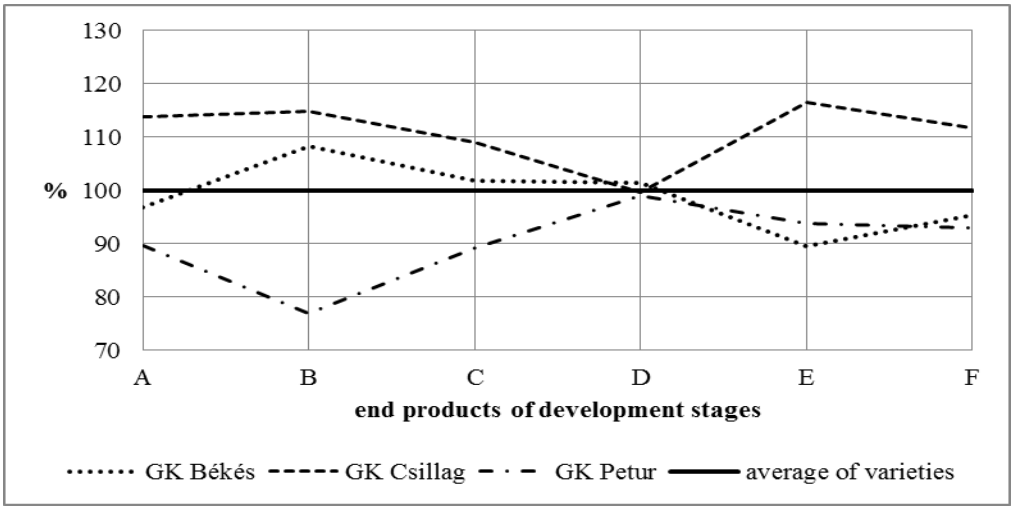

Fig. 1. Relative development of GK Békés, GK Csillag, GK Petur varieties on fertilizer 1 in 2010/2011. year

GK Csillag produced with 14% more shoots per unit area compared to the average, and its grains/spikelets was also favorable, but its shoots were non-productive, and its grains/spikelets and its thousand-seed weight was low (Figure 1.). Ultimately, GK Csillag created the largest grain per unit area. Among the examined varieties, GK Petur was the weakest in tillering. The number of ears per shoot and the number of spikelets per shoot showed an improvement compared to the other varieties, so the number of grains per unit area at the end of the development was slightly below the average of the varieties.

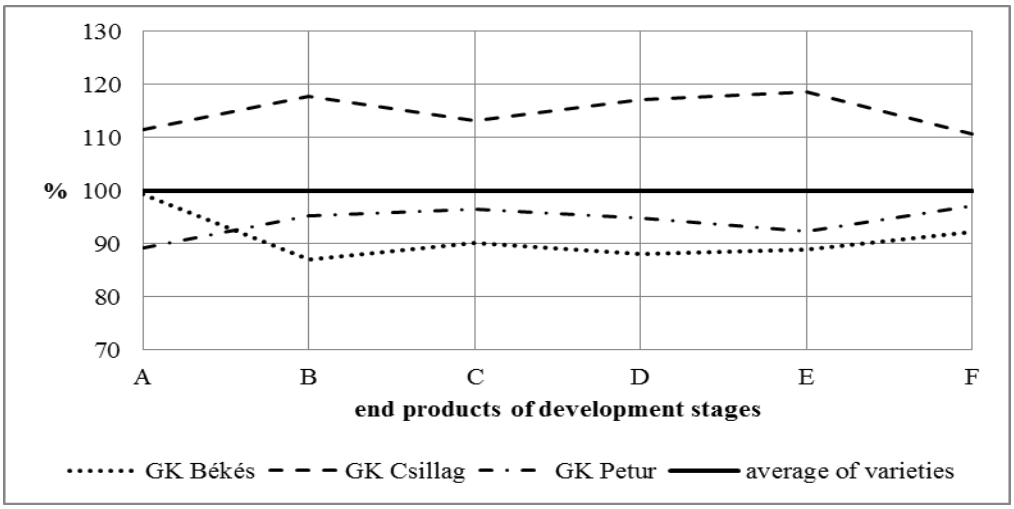

Fig. 2. Relative development of GK Békés, GK Csillag, GK Petur varieties on fertilizer 2 in 2010/2011. year

In the second fertilizer treatment (Figure 2.), the GK Csillag tillered the most again. Subsequent end products of development stages also far outperform the average of varieties, and at the end of the development, only 10% preceded the average. The initial development of the GK Békés and GK Petur varieties was below average and the results of the yield components were below average. Compared to the average, the thousand-seed weight of GK Békés and GK Petur was well established.

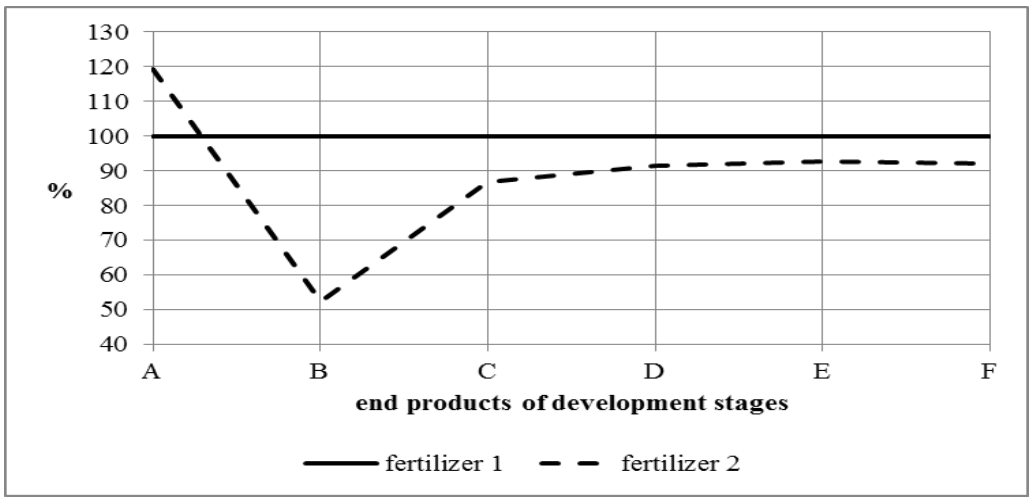

Fig. 3. Comparison of fertilizer 1 and fertilizer 2 in 2010/2011. year

In Figure 3, the yield components of the fertilizer 2 treatment were compared to the yield components of the fertilizer 1 treatment (100%).

The difference between the two fertilizer treatments is prominent in the number of shoot. The plants of fertilizer treatment 2, which did not receive the early spring N dose, could not tillered as much as those receiving N treatment. However, the small number of shoots of treatment 2 was more productive, as shown by the straight line between the B (number of shoot) and C (number of ears). Thus, the surplus nitrogen of fertilizer 2 treatment in April and early May was beneficial for the number of ears, number of spikelets, number of grains, and grain weight. However, the many but delayed N doses could not compensate for the arrears of plants of fertilizer 2 treatment, so the yield of the final stage end product, the yield per area unit, was less in fertilizer 2 treatment than in fertilizer 1 treatment.

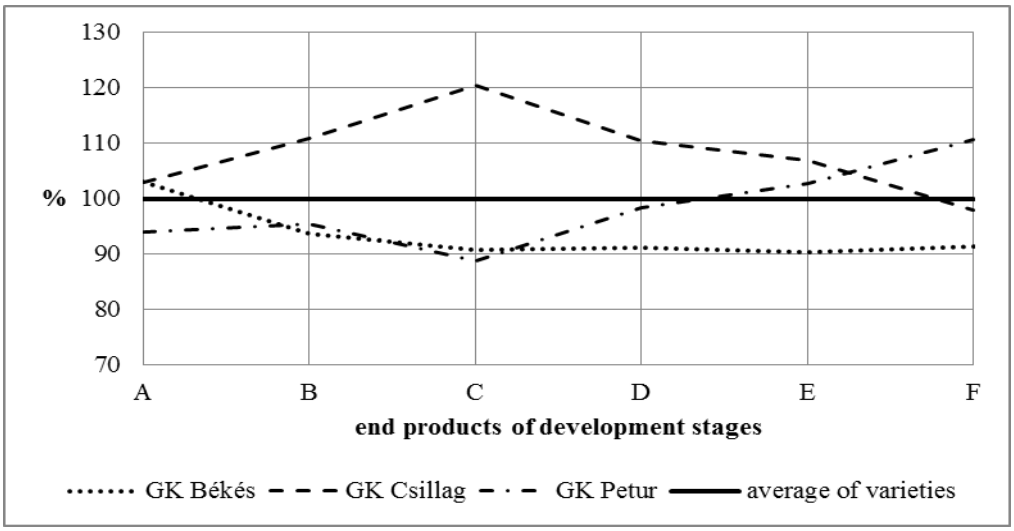

Fig. 4. Relative development of GK Békés, GK Csillag, GK Petur varieties on fertilizer 1 in 2011/2012. year

Figure 4 shows the developmental lines of the varieties studied in fertilizer 1 treatment 2011/2012, where the 100% level is the average end product of development stages of the varieties. In the second year of the experiment, in the case of fertilizer 1 treatment, it can be seen that the GK Csillag has again exceeded the other varieties in the case of shoots per unit area, number of ears per unit area and number of spikelets per unit area, and number of grains per unit area. However, the thousand-seed weight of GK Csillag is less than that of GK Békés and GK Petur, so the grain weight per unit area was 2% below the average of the examined varieties. The initial development of the GK Békés and GK Petur varieties (shoot number and number of ears) developed very similarly. Later, GK Petur developed more dynamically, its surpass with a number of spikelets/ears, number of grains/spikelets and thousand-seed weight not only of GK Békés, but also of the average of varieties. Thus, in the fertilizer 1 treatment of the second year of the experiment, the grain weight per unit area of GK Petur exceeded the variety average.

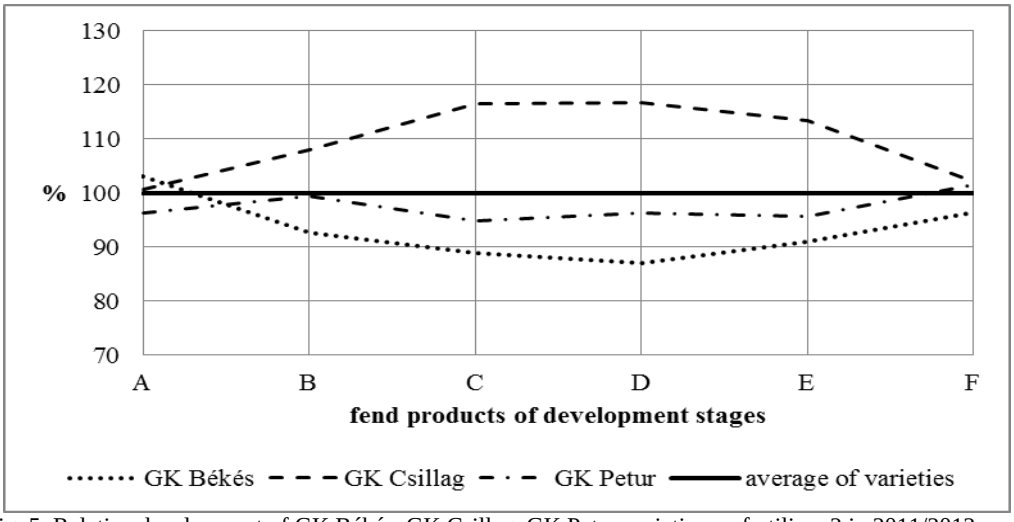

Fig. 5. Relative development of GK Békés, GK Csillag, GK Petur varieties on fertilizer 2 in 2011/2012. year

Even in the case of the fertilizer 2 treatment, GK Csillag stands out from the other varieties with its extraordinary tillering, the number of ears per unit area, the number of spikelets per unit area and the number of grains (Figure 5.). However, it can also be seen from the development line of GK Csillag that the grain size of the variety is small, so that it was able to prevent the average of the examined varieties slightly in the yield. The developmental lines of GK Békés and GK Petur are almost parallel. The two varieties are also below the GK Csillag variety by the number of shoots per unit of area, number of ears per unit area, the number of spikelets per unit area and weight of grains per unit area. They could not fully compensate for this backlog with their thousand-seed weight.

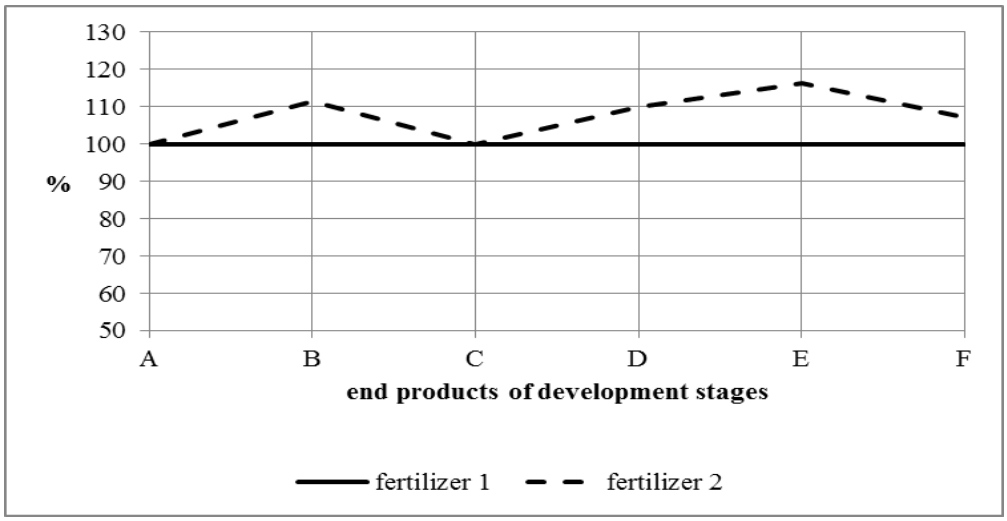

Fig. 6. Comparison of fertilizer 1 and fertilizer 2 in 2011/2012. year

In Figure 6, the yield components of the fertilizer 2 treatment were compared to the yield components of the fertilizer 1 treatment (100%) in the second year of the experiment.

We can see that in fertilizer 3 treatment the number of shoot per unit area is higher, but the number of ear is almost the same as the fertilizer 1 treatment. So, the effect of the later, continuous dosing of nitrogen resulted more shoots, which did not carry any ears, they became non-productive, but the surplus N had no effect on the formation of the ears. Excess Nitrogen not only contributed to the development of vegetative parts, but also generative parts improved: the number of spikelets per ears and the number of grains per spikelets were more favorable than those of the fertilizer 1.

CONCLUSIONS

- The examined genotypes have a characteristic development line, the relative positioning of their yield components shows the characteristic features of the variety:
  - GK Csillag is an extraordinarily tillering, number of shoot per unit area, number of ear, number of spikelet and number of grains are favorable.
  - GK Békés and GK Petur are characterized by a larger thousand-seed weight
- The plants which didn't get the early spring nitrogen dose, couldn't tiller as the ones received the N treatment in time.
- The April and May nitrogen surplus is beneficial for the ear number and grain number value of winter wheat.
- The delayed, higher doses of nitrogen fertilization cannot compensate the backlog of plants, so it is result poor yield.
- The continuous, issued in several installments N-dose is preferable for winter wheat, so it is result higher yield as a large amount of N applied to a few times

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