EFFECTS OF NITROGEN SUPPLY ON RATE OF WEIGHT OF STRAW AND EAR AND ON THE CHLOROFILL CONTENT OF THREE WINTER WHEAT VARIETIES

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Abstract: *The aim of our study was to determine the effect of N fertilization on the proportion of straw and ear of three winter wheat varieties, and to demonstrate the possibility of using Hydro N-Tester in precision crop production. 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. To determined the rate of weight of straw and ear in the full ripening of winter wheat, right before harvest samples were taken, in 3-3 replications for varieties and treatments. The relative chlorophyll concentration of the wheat leaf was measured using a Hydro N-Tester portable chlorophyll measuring instrument. Measurements were made for N-treatments and wheat varieties in the first year, four (April 6, April 15, May 5, May 17), and the second year at three times (April 18, May 4, June 7). We can conclude, that the rate of weight of straw and ear was hardly changed by fertilizer treatments, but rather the characteristics of varieties were enforced. Comparing the varieties in both years (2010/2011, 2011/2012)and in both fertilizer treatments, we found that the highest rate of weight of straw and ear was in GK Csillag variety and the lowest rate of weight of straw and ear in GK Petur variety. Hydro N-Tester is suitable for determining the N-supply of winter wheat, as a top dressing after a week was able to be measured in the leaves the change of chlorophyll amount. The values obtained with the Hydro N-Tester depend not only on the amount of N applied, but also on the varieties. It would be advisable to carry out more of these tests to detection the characteristics of the winter wheat varieties.*

Keywords: *winter wheat, nitrogen fertilization, N top dressing, rate of weight of straw and ear, Hydro N-Tester*

INTRODUCTION

According to LELLEY AND MÁNDY (1963), nitrogen contributes mainly to the vegetative development of wheat, but also affects the development of generative organs. DARWINKEL (2000) found that excessive N dosage results in a worse grain-to-straw ratio than optimal N care.

Variety and production site fertilization offers farmers the opportunity of precision wheat production. Previously, farmers were informed about the N-availability of the plant by costly, time-consuming and analytical tests requiring laboratory background work.

Today, a non-destructive instrumental test is available to determine this (MARÁCZI ET AL., 2011), which can be performed quickly in the field. VASILEVA ET AL. (2005) found correlations between the amount of chlorophyll in the leaf and the nitrogen content of the leaf.

Besides in rice (TURNER AND JUND 1991, PENG ET AL., 1993, JANAKI AND THIYAGARAJAN, 2004), the device was already tested in maize (PIEKIELEK ET AL., 1995, CHAPMAN AND BARRETO, 1997, RAJCAN ET AL., 1999), in potatoes (JONGSCHAAP AND BOOIJ, 2004, WU ET AL., 2007), in cotton (FEIBO ET AL., 1998) in woody plant cultures (CHANG AND ROBINSON, 2003, BAUERLE ET AL., 2004, PINKARD ET AL., 2006) and wheat (REEVES ET AL., 1993; FOX ET AL. HOEL 2005; ORTUZAR ET AL., 2005; ARREGUI ET AL., 2006; NAUD ET AL. 2009; KOZHUKHAR, 2010).

Young plants are best suited for assessing nutrient supply, as intense dry matter accumulation and growth does not begin in this stage of development. In young tissues, nutrient deficiencies are conspicuous; we can make up for any deficiencies by using top dressing or foliar fertilization. KOTEVA'S (2001) experiment with

Hydro-N-tester found that there is a context between nitrogen supply, meteorological conditions, fertilization and wheat yield.

The aim of our study was to determine the effect of N fertilization on the proportion of straw and ear of three winter wheat varieties, and to demonstrate the possibility of using Hydro N-Tester in precision crop production.

MATERIAL AND METHODS

Our experiments were carried out in Szeged – Öthalom 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).

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

To determined the rate of weight of straw and ear in the full ripening of winter wheat, right before harvest samples were taken, in 3-3 replications for varieties and treatments.

The relative chlorophyll concentration of the wheat leaf was measured using a Hydro N-Tester portable chlorophyll measuring instrument.

Measurements were made for N-treatments and wheat varieties in the first year, four (April 6, April 15, May 5, May 17), and the second year at three times (April 18, May 4, June 7).

RESULTS AND DISCUSSIONS

Comparing the varieties in both years and in both fertilizer treatments, we found that the highest rate of weight of straw and ear was in GK Csillag variety and the lowest rate of weight of straw and ear in GK Petur variety (Table 2).

Comparing the fertilizer treatments, it can be stated that in the first (2010/2011) year the lower dose, more balanced fertilization (fertilizer 1 treatment) resulted in a lower rate of weight of straw and ear than the higher dose delayed N fertilization (fertilizer 2 treatment).

In the second (2011/2012) year of the study, we could find even smaller differences between the single N top dressing (fertilizer 1 treatment) and the triple N top dressing (fertilizer 2 treatment) in rate of weight of straw and ear.

Table 2.

Proportion of straw and ear per fertilizer treatment in the examined varieties

number of treatments	varieties	2010/2011		2011/2012	
		straw	ear	straw	ear
fertilizer 1	GK Békés	1	1,07	1	1,64
	GK Csillag	1	1,35	1	1,84
	GK Petur	1	1,04	1	1,61
	average	1	1,15	1	1,70
fertilizer 2	GK Békés	1	1,20	1	1,77
	GK Csillag	1	1,43	1	1,78
	GK Petur	1	0,97	1	1,47
	average	1	1,20	1	1,67
Average		1	1,18	1	1,69

So we can conclude that the rate of weight of straw and ear was barely changed by the fertilizer treatments, but rather the characteristics of varieties were enforced.

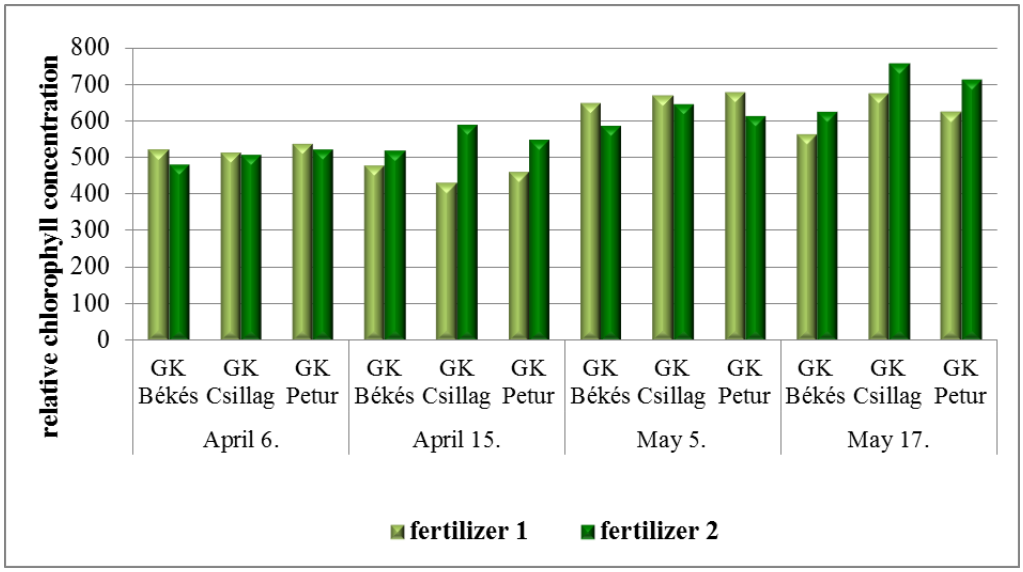

Fig. 1. Measurements with Hydro N-Tester on three winter wheat varieties in 2011.

On April 6th measurement we can be seen that, the chlorophyll content of all tested varieties was higher in fertilizer 1. treatment, so the effect of N top-dressing can be measured with the Hydro-N-Tester (Figure 1). We can observe that the varieties have reacted differently to the same N dose: the difference between the chlorophyll content was the highest in GK Békés and the smallest difference was found at the GK Csillag.

The effect of the next N fertilizer doses again was detected on 8 days after spread, the chlorophyll content of the fertilizer 2-treated plants was higher than that of the first treatments. At that time we experienced the greatest change in the GK Csillag, and the lowest chlorophyll content in GK Békés.

At the next measuring time (May 5) it can be seen that the leaves of the fertilizer 1 treatment plants again contained more chlorophyll.

7 days after the last treatment (May 17), it can be seen that higher values were measured for the plants of the fertilization 2 plots in all three varieties.

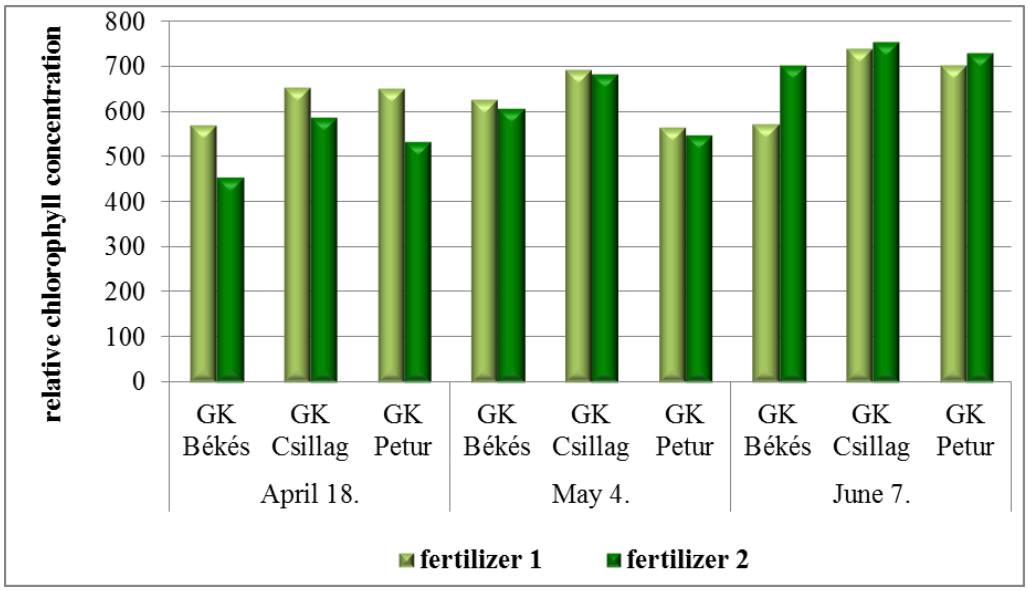

Fig. 2. Measurements with Hydro N-Tester on three winter wheat varieties in 2012.

Despite the same time and the same amount in the applied nutrient supply, the first measurements of the second growing season show that in the fertilizer management of all three varieties the relative concentration of chlorophyll was higher in the fertilization 1.

In April 2012, fertilizer 2 received 50kg ha^{-1} N, while fertilizer 1 treated parcels did not receive anything. Thus, we have already found that the difference in chlorophyll content has decreased for all three varieties.

From the last measurement of 2012, it can be stated that the relative chlorophyll concentration of all three varieties reached the highest results, and the fertilizer 1 treatment plants had a higher relative chlorophyll concentration than the fertilizer 2 treatment plants.

CONCLUSIONS

– The rate of weight of straw and ear was hardly changed by fertilizer treatments, but rather the characteristics of varieties were enforced

– Hydro N-Tester is suitable for determining the N-supply of winter wheat, as a top dressing after a week was able to be measured in the leaves the change of chlorophyll amount.

– The values obtained with the Hydro N-Tester depend not only on the amount of N applied, but also on the varieties.

– It would be advisable to carry out more of these tests to detection the characteristics of the winter wheat varieties.

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