# THE EFFECT OF SWEET MAIZE FORECROP AND NUTRIENT SUPPLY ON THE SPAD VALUES OF DIFFERENT WINTER WHEAT VARIETIES

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***Abstract***

*We have carried out our outdoor field experiments at the Látókép Experimental Farm of the CAAES of the University of Debrecen in the cropyear of 2012/2013 on chernozem soil in a long-term experiment. We have studied the effects of sweet maize forecrop on the development of the SPAD values of wheat varieties of different genotypes in the cases of control, $N_{60}$+PK and $N_{120}$+PK fertilizer treatments. According to our data, we have concluded that different winter wheat variety and fertilizer doses infleunced the SPAD values. According to research results, we got higher SPAD values after intensive variety except Mv Toldi. After extensive genotypes we have measured lower standard deviation range. The maximal SPAD values were measured in all genotypes at $N_{120}$+PK fertilizer treatments.*

**Key words:** winter wheat, crop rotation, nutrient supply, SPAD

## INTRODUCTION

The two decisive elements of winter wheat production are fertilization and crop rotation. In Hungary winter wheat one of the most important cereals, according to KSH (2012) data, a yield average of winter wheat 3.7 t ha$^{-1}$ on 1.06 million hectares.

Due to economic interests, the sowing structure of our country declined (to cereals and oil plants). According to BERZSENYI et al. (2000), the yield amounts of maize and wheat are always lower in monocultures than in crop rotations. During the last decades, the level of nutrient application also declined. According to PEPÓ (2002), the amount of utilized livestock manure decreased to one-sixth (it was 22-24 million tons in the 1970s, now it is only 3-4 million tons), and also quality problems aggravated the situation.

According to PEPÓ (2003), after sweet maize forecrop 5600-7000 kg ha$^{-1}$, after sunflower 5600-6900 kg ha$^{-1}$ maximum yields were obtained, depending on the genotype. According to the data from PEPÓ (2001), significant differences were observed between genotypes in the reaction to fertilizers.

Fertilization positively influences the plant physiological parameters; one of the most important one is the relative chlorophyll content (SPAD). According to WOOD et al. (1993), the Minolta SPAD is a manual equipment, that measures light (650 nm) absorption on the leaf surface, which can be an estimation of the chlorophyll and nitrogen content of the plant without destruction.

According to DENUIT et al. (2002), the SPAD values measured at the appearance of the flag leaf are influenced by the nutrient application, which positively effects yield amount. According to BELLIDO et al. (2004), in the phenpohase of flowering, the nitrogen content of the grain at ripening can be well estimated by the SPAD values.

**MATERIAL AND METHOD**

We have carried out our field experiments within a long-term experiment set on the Látókép Experimental Farm of the University of Debrecen CAAES RISF on calcareous chernozem soil in the cropyear 2012/2013. The fertilization and the plots of the forecrops (sunflower, grain maize) were set in four replications in split-band design. We have studied two extensive winter wheat varieties (GK Öthalom, Mv Toldi) and two intensive varieties (GK Csillag, Mv Csárdás) of different genotype.

During our research, we have studied three nutrient levels; in addition to the control treatment, N=60 kg ha$^{-1}$, $P_2O_5$=45 kg ha$^{-1}$ and $K_2O$=53 kg ha$^{-1}$; and N=120 kg ha$^{-1}$, $P_2O_5$=90 kg ha$^{-1}$ and $K_2O$=106 kg ha$^{-1}$ fertilizer doses. The whole P and K fertilizer doses were applied in autumn, while the first half of the N doses in autumn, the second half in spring. The fertilizer doses applied at the different nutrient levels are listed in *Table 1*.

*Table 1*

Applied fertilizer doses (Debrecen, 2013)

| **FERTILIZER TREATMENT (1)** | N | $P_2O_5$ | $K_2O$ |
|---|---|---|---|
| | kg ha$^{-1}$ | | |
| Control (2) | 0 | 0 | 0 |
| $N_{60}$+PK | 60 | 45 | 53 |
| $N_{120}$+PK | 120 | 90 | 106 |

On the basis of the measured temperature and precipitation data, the studied cropyear of 2012/2013 can be considered as a favourable. According to our research data, the precipitation was above the 30-year average by 79.3 mm. The lowest precipitation amounts were measured in October and November (22.4 -16.6 mm). The distribution of the precipitation was homogenous from October to the end of the breeding period.

The precipitation (Table 2.) fell in March was above the 30-year average by 102.8 mm, and the average temperature was lower by 2.1°C. The SPAD values of winter wheat were determined by Minolta SPAD 502 manual equipment. During the studied cropyear, we have measured the SPAD values five times, on the basis of the BBCH scale: at shooting (24/4/2013), at the 2-3-nodal stage (9/5/2013), at flowering (29/5/2013), at milky (10/6/2013) and at waxy ripening (29/6/2013). The obtained data were processed by Microsoft Excel. Our results demonstrate the average values of the 2012/2013 cropyear.

*Table 2*

Main meteorological data of vegetation period (Debrecen, 2012/2013)

| Months | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | Total/Average | Difference |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Percipitation (mm) 2013 | 22,4 | 16,6 | 65,8 | 38,7 | 52,9 | 136,3 | 48,0 | 68,7 | 30,8 | 480,2 | 79,3 |
| 30 year's average | 30,8 | 45,2 | 43,5 | 37,0 | 30,2 | 33,5 | 42,4 | 58,8 | 79,5 | 400,9 | - |
| Temperature (°C) 2013 | 11,1 | 7,2 | -1,2 | -1,0 | 2,3 | 2,9 | 12,0 | 16,6 | 19,6 | 7,72 | 0,79 |
| 30 year's average | 10,3 | 4,5 | -0,2 | -2,6 | 0,2 | 5,0 | 10,7 | 15,8 | 18,7 | 6,94 | - |

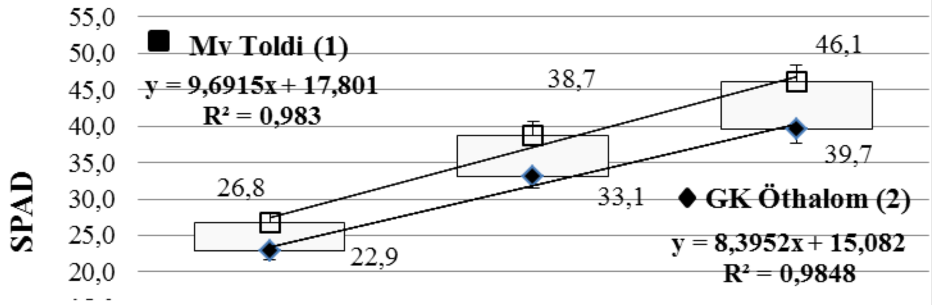
October (2), November (3), December (4), January (5), February (6), March (7), April (8), May (9), June (10),

**RESULTS AND DISSCUSIONS**

SPAD values measured in long-term experiments are shown in diagram 1 and 2. Crop year 2012/2013 is considered as favourable based on results of measuring of precipitation and temperature, which materially determined the development of plants. All differences between genotypes at the same extent have equalized.

Positive and negative differences in measured SPAD values of genotypes are demonstrated by the rectangle between varieties (diagram 1. and 2). According to our results, differences between SPAD values of extensive and intensive genotypes after sweet corn forecrop were little. Among extensive genotypes, we detected the highest SPAD value with the smallest dispersion of values (2.5-5.9) with genotype Mv Toldi.

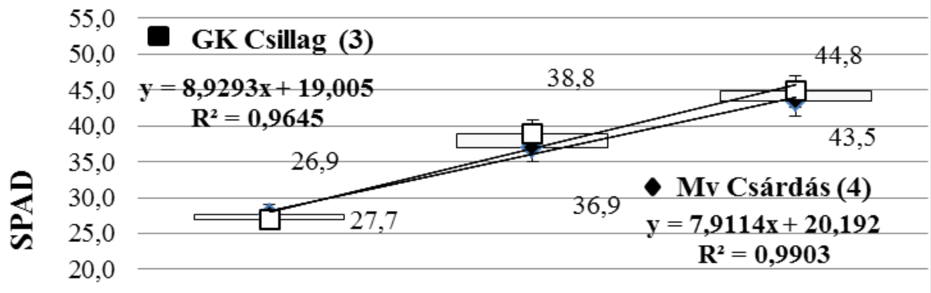
In case of variety GK Öthalom, with the examined nutrient treatments, SPAD values were considerably lower compared to those of Mv Toldi, and with larger dispersion (4.2-6.7). This indicates that genotype Mv Toldi reacted more advantegously to weather conditions in the analysed crop year. $R^2$ values of the varieties were in 0.9830-0.9848 interval, which is regarded as close correlation.




| Average: | Kontroll | N60+PK | N120+PK |
|---|---|---|---|
| GK Öthalom (2) | 22,9 | 33,1 | 39,7 |
| Mv Toldi (1) | 26,8 | 38,7 | 46,1 |
| **CV:** | | | |
| Mv Toldi (1) | 4,3 | 5,9 | 2,5 |
| GK Öthalom (2) | 4,2 | 6,7 | 5,2 |

**Fertilizer doses (3)**

Fig. 1 Extensive genotypes SPAD values during the cropyear after sweet maize forecrop




| Average: | Kontroll | N60+PK | N120+PK |
|---|---|---|---|
| Mv Csárdás (4) | 27,7 | 36,9 | 43,5 |
| GK Csillag (3) | 26,9 | 38,8 | 44,8 |
| **CV:** | | | |
| GK Csillag (3) | 3,2 | 7,8 | 6,1 |
| Mv Csárdás (4) | 3,8 | 9,0 | 5,3 |

**Fertilizer doses (3)**

Fig. 2 Intensive genotypes SPAD values during the cropyear after sweet maize forecrop (Debrecen, 2013)

Diagram 2. shows SPAD values of intensive varieties in the nutrient treatments. Difference between SPAD values of GK Csillag and Mv Csárdás was much more balanced than that between those of extensive varieties.

Results reveal that SPAD values of GK Csillag proved to be better on a minimal extent with $N_{60}$+PK and $N_{120}$+PK nutrient treatments.

Dispersion values were the highest with $N_{60}$+PK nutrient treatment (7.8-9.0), similarly to extensive varieties (5.9-6.7).

According to the data gained in our research, $R^2$ values (0.9645-0.9903) corroborate close correlation.

## CONCLUSIONS

Our research data obtained from long-term experiment proved that variety choice had a positive effect on SPAD values.

Between the examined varieties we observed differences which were determined by the ability of the variety to adapt.

According to our research data, SPAD values of extensive variety Mv Toldi were higher than those of genotypes GK Csillag and Mv Csárdás.

Differences between intensive varieties were significantly more equalized, which was positively affected by fertilizer treatment.

Data shows that the lowest SPAD values were measured in the control treatment, which confirms research data of DENUIT et al. (2002).

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