The Effect Of Fertilization And Previous Cropping Of Sunflower On The Yield And The Values Of Spad Values Of Winter Wheat

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Abstract

Our research was carried out in a long-term experiment, in two different growing seasonsafter sunflower previous cropping with control, N_{60}+PK and N_{120}+PK fertilizer treatments, with genotypes GK Csillag and Mv Csárdás. According to the results, in the examined seasons, significant differences in productivity were observed between the varieties. In the more favourable crop year of 2013/2014 - with similar agricultural techniques and fertilization -, a considerable increase were detected in the control treatment (+248.8 – 263.7 %), with N_{60}+PK (185.7 – 220.5 %) and with N_{120}+PK (126.5 – 138.2 %) fertilizer treatments, compared to growing season 2012/2013. Based on the obtained data, due to fertilization and to the effect of the more favourable crop year, SPAD values were higher compared to those of growing season 2012/2013.

Keywords: winte wheat, fertilization, crop rotation. yield, Spad

Introduction

One of our most important cereal crops is winter wheat. As per the data of the Central Statistics Office (2014), the average yield was 4.71 t ha^{-1}, which was strongly affected by the favourable crop year. In our country, winter wheat is grown on approximately 1.1 M hectares, in changing conditions, which is determined primarily by, besides the crop rotation and the nutrient supply, the crop year and the standard of the available agricultural techniques. According to PEPÓ (2004), in the period between 1985 and 2003, the 57.7% loss of production in the average of the varieties was attributable to the direct and indirect unfavourable effect of the weather, while with optimal fertilizer treatments this loss could be significantly decreased. According to SÁRVÁRI (2009), wheat needs nitrogen, but is also sensitive to the phosphorus supply. The optimum amount of nitrogen was 50 kg/N/ha after pea and 100 kg/N/ha after corn previous cropping, with the given conditions. From among the physiological factors of plants, one of the most important ones is the chlorophyll content in the leaves. According to WOOD et al. (1993), the Minolta SPAD appliance is a small manual spectrometer that measures the adsorption of light (650 nm) on the surface of the leaf, which is a non-destructive gauge of the chlorophyll and nitrogen content of the plant. According to SZILÁGYI (2014), maximum SPAD value (42.8) was observed with N_{120}+PK fertilizer treatment in lactic ripeness (BBCH 73-77), after sunflower previous cropping. Our data show significant differences between the varieties. FEKETE et al. (2014) found conformance between the yield and the SPAD values. Their results revealed that the SPAD values measured in May determined the yield the most. When the SPAD values were less than 45, the yield was maximum 5.5 ha^{-1}.

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Material and Method

Our long-term experiment took place on the test farm of University of Debrecen CAAES Faculty of Agricultural and Food Sciences and Environmental Management Institute of Crop Sciences, on calcareous chernozem soil in growing seasons 2012/2013 and 2013/2014. We examined to different genotypes (GK

Csillag, Mv Csárdás) after previous cropping of sunflower. The experiment were arranged in 4 replicates in split bands.

We examined three different nutrient level. Besides the control treatment we spread dosages of N=60 kg ha^{-1}, P_2O_5=45 kg ha^{-1} and K_2O=53 kg ha^{-1}; N=120 kg ha^{-1}, P_2O_5=90 kg ha^{-1} and K_2O=106 kg ha^{-1}. We spread the nitrogen in 50-50% autumn and spring split, and spread 100% of the phosphorus and potassium dosages in autumn.

Table 1. Applied fertilizer doses (Debrecen, 2013)

Fertilizer treatment	N	P_2O_5	K_2O
	kg ha^{-1}		
Control	0	0	0
N_{60}+PK	60	45	53
N_{120}+PK	120	90	106

Based on our temperature and precipitation data, the two different growing seasons (2012/2013 – 2013/2014) can be considered as favourable. According to our data, there was 480.2 mm rainfall in growing season 2012/2013, and 284 mm in growing season 2013/2014. However, during growing season 2013/2014 the average temperature of January and February was mild compared to the average of the previous 30 years, which resulted in the fast development of winter wheat at the beginning of the growing season. We made our measurements based on the BBCH-scale, during run-up (BBCH 30-37), flowering (BBCH 61-69), lactic (BBCH 73-77) and grain ripening (BBCH 83-89).

The acquired data had been averaged. The tested stands were harvested with Sampoo parcel combine harvester. SPAD results were defined with Minolta 502 appliance. Our results were analysed by Microsoft Excel programme. Our field results show the development of the yield and the SPAD values in the tested growing seasons.

Results and Discussions

Our field experiments show how the SPAD values and the yield changed, which is demonstrated in figure 1. According to our data, considerable differences occurred after sunflower previous cropping, which was primarily due to the effect of the crop year. Our results show that the average yield was significantly higher in growing season 2013/2014 than in growing season 2012/2013. The percental differences of the yield is demonstrated in table 2. During the examined growing seasons, variety GK Csillag reached a higher yield than variety Mv Csárdás did, in every combination of fertilizer treatments.

In growing season 2012/2013, the difference between the two varieties changed in a small interval, however, Mv Csárdás produced higher yields in more favourable crop year conditions with control (0.70 t ha^{-1}), N60+PK (1.94 t ha^{-1}) and N_{120}+PK (1.75 t ha^{-1}) fertilizer treatments.

Table 2. Percental differences of the yield between growing seasons 2012/2013 and 2013/2014 (Debrecen)

Gk Csillag			Mv Csárdás		
Control	N_{60}+PK	N_{120}+PK	Control	N_{60}+PK	N_{120}+PK
+263.7	+185.7	+126.5	+248.7	+220.5	+138.1

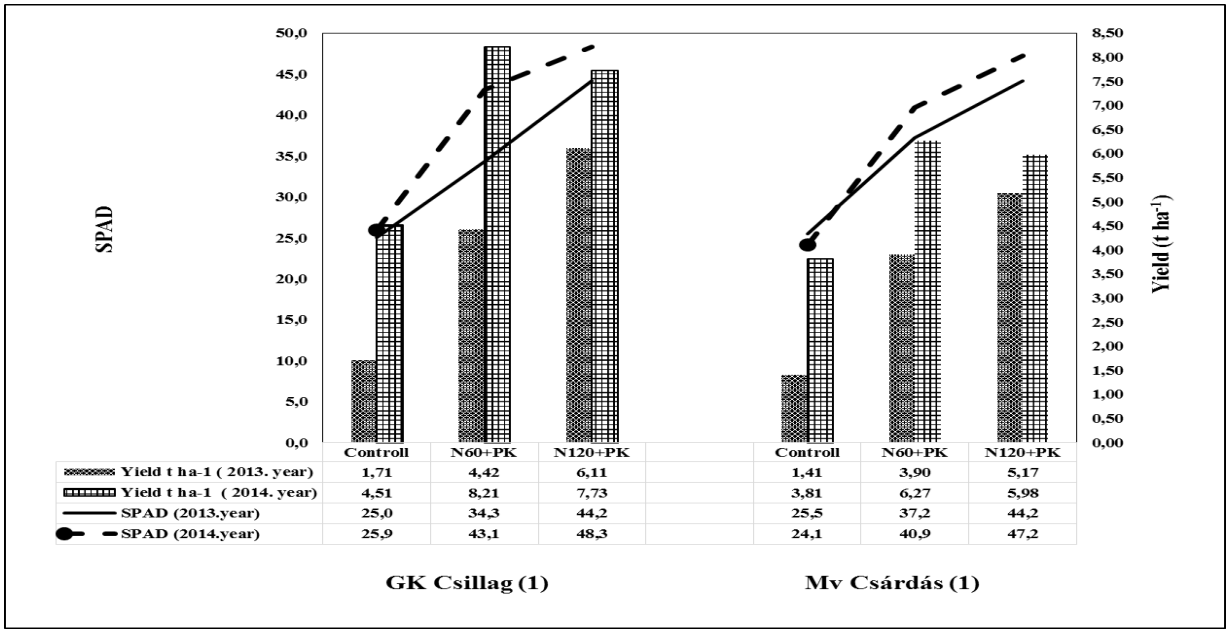

Figure 1. Chlorophyll content (SPAD values) and yield after sunflower previous cropping (Debrecen, 2012/2013-2013/2014)

Between SPAD values in growing season 2012/2013 a small difference was observed. As an effect of fertilization, SPAD values of the tested varieties were 9-10 units higher with N60+PK treatment compared to that with the control treatment. A Similar trend was detected between the N_{60}+PK and N_{120}+PK treatments. In the more favourable growing season 2013/2014, with the increased dosages of fertilizer treatments, SPAD values were more than 40. Maximum values were measured with N120+PK treatment with variety GK Csillag (48.3). The regression analysis of SPAD values indicated close correlation during the examination of the varieties (R^2=0.9127-0.9794), while between the growing seasons only a slight difference was detected (figure 3).

Table 3. Polynomial regression equations (Debrecen, 2013-2014)

Genotypes	GK Csillag	Mv Csárdás
SPAD (2013.year)	$y = -1.0066x^2 + 5.0376x$ $R^2 = 0.9715$	$y = 9.35x + 16.933$ $R^2 = 0.9794$
SPAD (2014.year)	$y = 11.2x + 16.7$ $R^2 = 0.9127$	$y = 11.55x + 14.3$ $R^2 = 0.9356$

Conclusion(s)

Based on our research carried out in a long term experiment we have detected the strong effect of the crop year to the yield and its milder effect to the SPAD values. Our data prove research results of PEPÓ (2004). Our data confirm research results of SZILÁGYI (2014) and FEKETE et al. (2014). Our yield related results show that the choice of varieties has an essential role, since we measured a high yield ((+1.94 t ha^{-1}) during the examination of the varieties.

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