The comparison of spring to early summer SPAD values of various winter cereals

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Abstract: From the beginning of the history of mankind cereals are the most important crop plants. It can be stated in case of Hungary as well, where normally, during the past centuries, two third of the arable land is used for cereal cropping.
Cereals are produced for their carbohydrate content, a primary product of photosynthetic assimilation. Plants manufacture organic matter from atmospheric CO_2 and water taken up by the root system from the soil. Although photosynthesis is driven by abiotic environmental factors, agronomic technologies have remarkable impact on it. Therefore producers should obtain information about its performance.
New technologies give us tools for remote sensing like SPAD that gives reliable value for photosynthetic activity. To use it in an appropriate way, it should be calibrated somehow for each species and varieties.
Our aim in this work was to make reference values for the most critical phenology of different species and varieties of winter cereals. Characteristic differences were found for each of them that can be used for clarifying further technologies.

Keywords: cereal, SPAD value

Introduction

In Hungary, agricultural production has long been a major issue as almost half of the country’s land is arable. In Hungary, just as in the entire world, cereals represent the most plausible source of human alimentation, hence, for a very long time, winter cereals were the most commonly cultivated crop species. There exist numerous factors that have effect on yield (Tarnawa & Klupács, 2006; Horváth, 2014) and among them there are some that could be influenced by the farmer and also some that could not be. The first group is the set of elements of agronomic management the second group is the set of factors of the environment (Várallyay et al., 1985). In the set of environmental factors there are some with more or less effect on yield (Klupács et al., 2010). Even because cropping technologies are not an indoor practice but mostly outdoor; the weather and climate represent a high environmental impact (Láng et al., 2007), and according to former observations, weather plays a significant role (Szöllősi et al., 2004).

The most critical technological points in winter cereal production are agrochemical applications, so that it is essential to reveal and study soundly their impacts (Birkás, 2006). According to the strategy of sustainable agricultural one of the basic principles is to produce safety goods and supply customers with healthy food. Hence we have to deal with chemicals, for example nutrients given as inorganic chemical fertilizers not to overdose. Many inputs and practices used by conventional farmers are also used in sustainable agriculture. The goal is to develop efficient biological systems, which do not need high levels of material inputs. Chemical inputs are seen by the public to be a primary cause of food contamination and environmental pollution arising from agriculture (Jolánkai et al., 2006). Sustainable approaches are those that are the least toxic and least energy intensive, and yet maintain productivity and profitability (Várallyay 2006). As yields still show lower or higher fluctuation from the long term averages or trends, it should be more than useful to explore how it depends on each element of climate (Pepó, 2010) and technology.

The nitrogen regime of plants has high importance in photosynthetic activity. Strong connection could be found even visually between the color of a crop plant and N supply. That colour, and in parallel the chlorophyll activity can be estimated in an objective way by SPAD analyzer that generates indices on N supply of plants on field. As it measures without destruction, it can be used in different phenological status (Ványiné 2008).

To be able to use the SPAD method for N supply estimation it is necessary to have points to accord. In former studies it was found that even between varieties there can be observed big differences in SPAD values. In this paper our aim is to make reference values for the most critical lifetime of several species and varieties of winter cereals. If characteristic differences could be found for each of them, it can be used for clarifying further technologies.

Materials and methods

At the Gödöllő campus of Szent István University a set of winter cereals were sown on micro-plots (1 m^2 each) for demonstrational purposes. Among these items normal wheat (Mv Karéj, Mv Nádor, GK Körös, GK Csillag), hybrid wheat (Hyland), special wheats (Mv Alkor, Mv Menket, Mv Hegyes), durum and spelt wheat (Mv Hundur Franckenkorn), triticale (Tátra, Mv Sámán), rye (Várda), barley (Giga, Korsó, KG Puszta) and winter oat (Mv Hópehely) could be found. Items and the relations between them can be seen in Table 1.

The observation was made in 2015 that was a normal cropyear for winter cereals. The soil of that site is forest brown that is favourable for producing those crops.

Table 1. The items studied in the experiment – name of items and the relations between them.

glum		taxonomy: genus	taxonomy: species	Name of item	group
nude	*Triticum* genus	*Triticum*	*aestivum*	Mv Karéj	1
				Mv Nádor	
				GK Körös	
				GK Csillag	
			aestivum, hybrid	Hyland	2
			monococcum	Mv Alkor	
				Mv Menket	
			dicoccum	Mv Hegyes	
			spelta	Franckenkorn	
			durum	Mv Hundur	
	other than *Triticum* genus	*Triticosecale*	×	Mv Sámán	3
		Secale	*cereale*	Várda	
		Triticosecale	×	Tátra	
glumous		*Hordeum*	*vulgare*	Giga	4
				Korsó	
				KG Puszta	
		Avena	*sativa*	Mv Hópehely	

In one of the most critical period, the late spring to early summer, chlorophyll activity was estimated by SPAD-502 PLUS analyzer in different phenological stages. On nine occasion the estimations were made: 23rd April, 27th April, 30th April, 3rd May, 7th May,

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22nd May, 28th May, 1st June, 11th June. The SPAD values were measured on them regularly in 10 repetitions for each plot in each time. On the series the statistical analysis was performed by using the MS Excel program package.

Results and discussion

On figure 1 to 4 the averages of the measurements could be seen. On figures the solid lines refer for each item but dashed lines are for average of a bigger group. As there are so many items, groups were made along the taxonomical distance. Label of groups can be seen in the last column of table 1.

The first group is formed by the four *Triticum aestivum* varieties. The average results can be seen on figure 1. Even the difference between them seems to be big, the shape of curves are similar; the place of local maximum and minimum point are together for most of them.

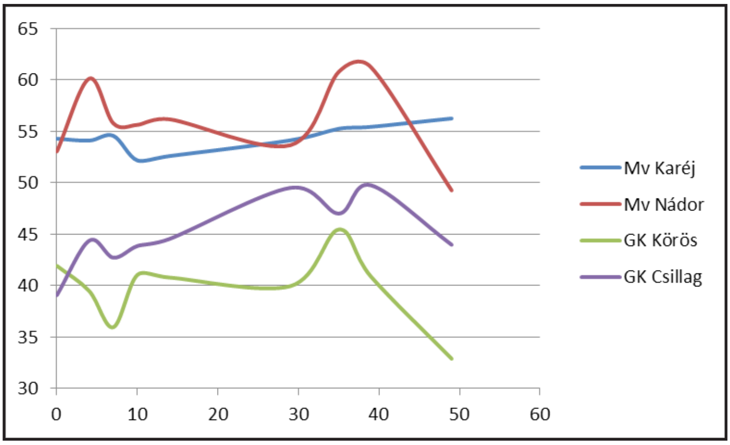

Figure 1. The average result for Triticum aestivum varieties (group 1)

Second group includes other varieties from the *Triticum* genus. On figure 2 the average SPAD values for them can be seen with the combined average of group 1. Even that group comprises numerous varieties, lower differences can be found in value but bigger variation in the shape of curves.

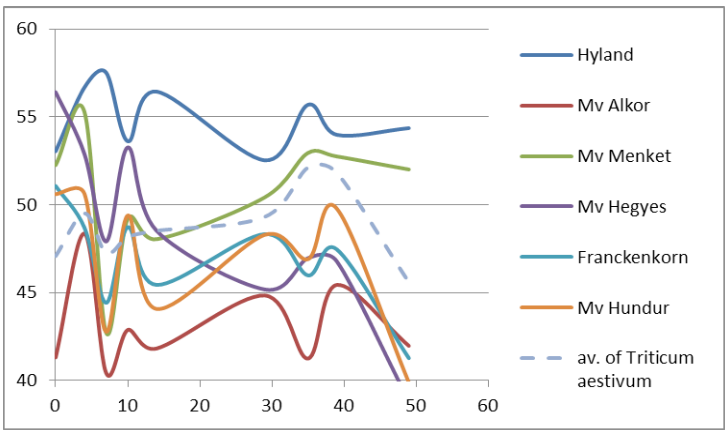

Figure 2. The average result for Triticum varieties (group 2) with the combined average of Triticum aestivum varieties (group 1)

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Third group is made on nude cereals besides the *Triticum* genus, namely rye and triticale. The rye is comparatively close to wheat as they can be hybridized that results the triticale. As the triticale is closer to wheat, it can be noticed in the similarity to average curves of wheat groups. Rye is differing a bit more (figure 3).

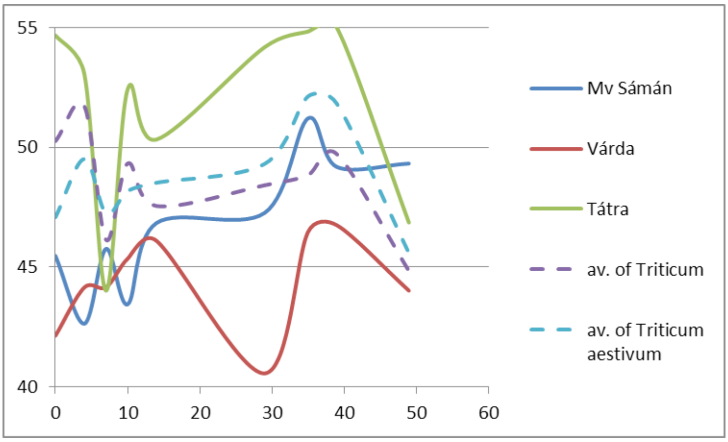

Figure 3. The average result for non-Triticum nude cereals (group 3) with the combined average of Triticum aestivum varieties (group 1) and Triticum varieties (group 2)

The last group is a kind of miscellaneous as barley and oat is in it, the base of forming it is that they are all glumous. It can be seen well on figure 4 that the curves of the three barley varieties go similarly but the oat variety (Mv Hópehely) has a diverse performance. As the ripening of barley is earlier, it can be seen that average values are in decline for the last days of measurement.

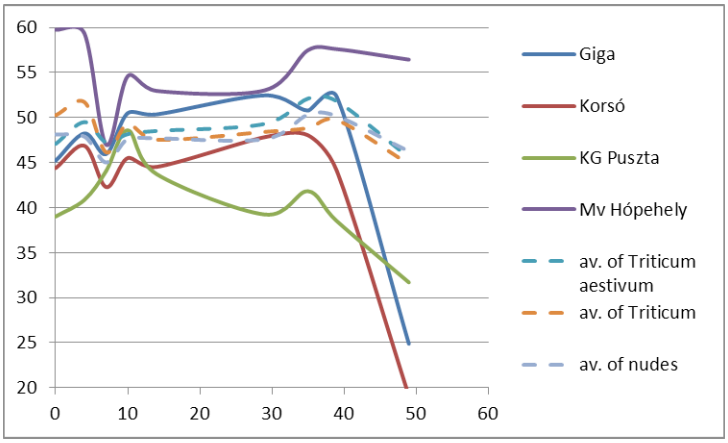

Figure 4. The average result for glumous cereals (group 4) with the combined average of Triticum aestivum varieties (group 1), Triticum varieties (group 2) and non-Triticum nude cereals (group 3)

It can be stated that remarkable differences occurred between the averages. Also, the differences show close correlation with taxonomical distances of the species and varieties examined.

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Conclusions

Evaluating the results obtained it can be concluded that it is necessary to have reference values not only for each species but for every variety.

The differences in pattern of averages seem to be correlated with taxonomical distances of the crop varieties examined.

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