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ORIGINAL PAPER

DIFFERENCES IN THE DEGREE OF NUTRITION OF POTATO PLANTS GROWN UNDER ORGANIC AND CONVENTIONAL SYSTEMS – AN ATTEMPT TO DEVELOP A MODEL OF PLANT FEEDING*

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Abstract

The experiment was conducted in 2017-2019, at the Plant Breeding and Acclimatization Institute, in central Poland. Potatoes were grown in two systems, i.e. organic and conventional. Eight potato varieties from different maturity classes were tested. The SPAD leaf greenness index was measured every 10 days starting from the moment when the plants in the rows were closed, i.e. from about 45 days after planting, to the beginning of maturity. It was determined that the value of the SPAD index depended on all the examined factors, i.e. production system, variety, years and the date of measurement (physiological state of the plant). In both production systems, the highest leaf greenness index was obtained in the first measurement period, i.e. approx. 45 DAP. The response of varieties from different maturity groups was different. The very early varieties grown under the organic system did not achieve an optimal SPAD value of 43.8 at all. The mid-early and early varieties kept this value up to 55 DAP. In the conventional system, very early varieties maintained this value until 55 DAP, and early and mid-early varieties up to 65 DAP. The tuber yield in the organic system was 44.5% lower than in the conventional system. A significant positive correlation was found between the SPAD value and the tuber yield. In the organic system, the amounts of most macro- and microelements were generally higher than in the conventional system. The exception was nitrogen, the content of which in tubers from organic cultivation was lower than from conventional one. The research data can be used to develop a model of nitrogen feeding of potato varieties from different maturity groups cultivated in different production systems.

Keywords: potato, organic system, conventional system, SPAD, cultivar, yield, macro and micronutrients.

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INTRODUCTION

Global trends in agriculture are moving towards environmentally friendly systems. However, in these systems, especially in the organic one, there are certain restrictions that limit the level of yields. There are limits on the use of pesticides and a deficit of nutrients appears in some soils as a result of non-mineral fertilizers. These limitations affect plant growth and, consequently, the tuber yield and its structure. Plants growing under the organic system are characterized by lower aerial mass and smaller leaf greenness (Van Delen 2001, Erich et al. 2006, Zarzyńska, Szutkowska 2012, Zarzyńska, Pietraszko 2015, Lynch et al. 2021) Indeed, organic restrictions on fertilization mainly cause reduced N availability, resulting in a detrimental effect on potato plant growth and tuber development (Clark et al. 1999, Coelho et al. 2010, Dvorak, Kral 2019). Development of aerial plant parts is largely determined by the supply and availability of nitrogen in the first weeks after emergence (Elen et al. 2003, Love t al. 2005, Goffart et al. 2008, Marschner 2012) and the time of flowering when the tuberization process begins. Nitrogen is the soil nutrient which most affects the yield production in both systems. However, mineral forms of nitrogen are very labile in soil, and very heavy rainfall during the growing season can cause leaching, which can result in malnutrition and consequently affect yield (Haverkot, Mac Kerron 2000, Goffart 2008, Trawczyński 2019*b*). Optimizing nitrogen (N) use achieves multiple goals. It enhances tuber quality and storability, preserves groundwater quality and minimizes costs. Lower nitrogen fertilization improves the quality composition of tubers, owing to the reduction of undesirable components, e.g. nitrates, and – on the other hand – to the increase in the number of ingredients beneficial to human health. Matching the supply of nitrogen and plant demand is the key to improving fertilizer efficiency. The degree of plant nutrition is very important information for the plant producer. Having data on the level of the plantation nutrition, we can always take steps to improve this condition by applying plant feeding. In the conventional system, it is easier due to the lack of restrictions on the use of fertilizers. Under the organic system, such restrictions exist, but there are quite many fertilizers that can be used. Optimization of nitrogen fertilization of potatoes can be achieved by foliar application of supplementary doses of this compound during the plant growing season, based on a diagnosis of their nutritional status (Lombardo et al. 2020*a*). Precise assessment of the nutritional status can be made by using direct and indirect chemical methods. The most frequently used chemical methods include the total nitrogen test, NNI test and SPAD test. The use of these methods to assess the nutritional status allows for precise determination of the nitrogen content in the indicator parts of the tested plants. The chlorophyll content in leaves is closely related to the nitrogen content in the plant (Vos, Bom 1993, Tremblay 2004, Majic et al. 2008, Ramirez et al. 2014). The SPAD test (Soil Plant Analysis System), otherwise known as the measurement of the leaf greenness index, has gained great popularity in recent years owing to the possibility of making measurements in a non-destructive manner. For this type of analysis, we use devices called chlorophyllometers, which enable the assessment of nitrogen nutrition by measuring the content of chlorophyll on the basis of the leaf greenness index. Both Polish and foreign studies (Li et al. 2012, Puiu et al. 2012, Trawczyński 2019*a*, Żołnowski et al. 2021) report that the SPAD test performed with an N-Tester is the most prospective and useful technique in agricultural practice owing to the ease of performing non-invasive measurements of the chlorophyll in leaves. A test performed with an N-Tester is relatively simple and rapid, as measurements are carried out in a field directly on leaves of plants while preserving their integrity. Repeated multiple times during a growing season, these measurements can be used for precise nitrogen dosing, thus preventing yield reduction or accumulation of nitrogen in the environment (Goffart et al. 2008, Trawczyński 2019*a*, Żołnowski et al. 2021).

The aim of our research was to determine the differences in the value of the SPAD leaf greenness index of potato varieties from different maturity groups grown under the organic and conventional systems and, on this basis, to develop a model of plant supplemental fertilization with nitrogen during the growing season, depending on the production system.

MATERIAL AND METHODS

A study was conducted in the years 2017-2019, at the Plant Breeding and Acclimatization Institute, in central Poland, on the lessive soil with the grain size composition of light clay sand. Potatoes were grown in two systems, i.e. organic and conventional. Organic plantation has been carried out for 15 years. The following crop rotation was used in the organic system: potato → spring barley → mixture of field peas with fodder peas and spring rye → mixture of yellow lupine and oats → rye with seradella seeding. In the conventional system, the crop rotation was as follows: potatoes → spring wheat → winter wheat → lupine. The two systems also differed in fertilization, weed control and insect control practices (Table 1).

During the growing season, measurements of the most important weather factors were carried out. The results of the measurements are presented in Table 2. Eight potato varieties were chosen for this study based on maturity classes (very early – 60-90, early – 91-110 and mid-early – 111-125 days of vegetation) and resistance to late blight (Table 3). All varieties were planted manually (whole tubers) at the same time, i.e. about 20 of April. The plot size was 84 m^2 and the trials were conducted in three replications. Plants were grown at 75x33.3 cm spacing. The SPAD leaf greenness index was mea-

Table 1

Agronomic inputs in organic and conventional systems

Crop production practice	Organic system	Conventional system
Fertilization	manure – 28 t ha^{-1} + mustard as a catch crop	4-5 t ploughed rye straw + 1 kg mineral nitrogen per 100 kg straw N – 100 kg ha^{-1}, P – 53 kg ha^{-1}, K – 150 kg ha^{-1}
Weed control	only mechanical tillage	mechanical tillage + herbicides: Linurex: 1,8 l ha^{-1}, Titus + Trend 60 g ha^{-1} + 0,5l ha^{-1}
Colorado potato beetle control	biological insecticide: Spin Tor 240 SC (Spinosad) 2x per season 0,15 l ha^{-1}	chemical insecticides: Actara – 2 x per season 60 g ha^{-1}, Apacz 40 g ha^{-1}
Late blight control	copper fungicides: Miedzian 50, 3 l ha^{-1} 2x per season	chemical fungicides: Ridomil 2 l ha^{-1}, Revus 0,6 l ha^{-1}, Ranman 0,2 l ha^{-1}, Altima 0,4 l ha^{-1}

Table 2

Total monthly rainfall – P (mm) and mean monthly temperatures – T (°C) during the vegetative growth period in the years 2017-2019 for Jadwisin

Year/ Month	04		05		06		07		08		09		Sum/Mean	
	P	T	P	T	P	T	P	T	P	T	P	T	P	T
2017	8.9	7.3	10.1	14.1	107.5	18.1	78.8	18.4	57.0	19.4	140.8	13.8	407.1	15.2
2018	21.7	13.2	43.4	17.6	41.0	19.1	75.2	21.2	60.6	20.8	30.9	15.8	272.8	18.0
2019	1.7	10.2	76.6	13.4	6.9	22.7	33.4	18.8	37.0	20.8	60.8	14.7	216.4	16.8
Long-term average	34	8.8	57	11.6	75	18.7	75	19	61	20.1	49	15.5	351	15.6

Table 3

Characteristics of potato varieties evaluated in organic and conventional production systems during 2017-2019 (Nowacki et al. 2019)

Variety	Maturity group	Resistance to *Phytophthora infestans**
Justa	very early	3
Tacja	very early	3
Lawenda	early	4
Magnolia	early	4.5
Laskara	mid early	4.5
Lech	mid early	5
Mazur	mid early	4.5
Otolia	mid early	4.5

* 9 – full resistance, 1 – no resistance

sured every 10 days for each system and cultivar, starting from the moment when the plants in the rows were closed, i.e. from about 45 days after planting to the beginning of maturity. Measurements were made on 10 plants by selecting the third-order apical leaf. During the entire growing season, 5 measurements were taken. Evaluation of the total chlorophyll content was based on the leaf greenness index measured by a SPAD 502 (Soil-Plant Analyses Development) chlorophyllmeter (Konica-Minolta, Japan). During harvest (after about 160 days after planting), the yield of tubers from each variety from both production systems was determined.

Statistical analyses of the results were performed with an analysis of variance and regression using Statistica software (StatSoft, Poland). The significance of the sources of variation was tested with the Fisher--Snedecor test, and the significance of differences was assessed by the Tukey's test at significance $p<0.05$.

RESULTS AND DISCUSSION

The significance of studied factors differentiation

The analysis of variance carried out showed the significance of differences in the SPAD index values depending on the production system, variety, measurement date, maturity group of varieties and year. The significance of the interaction of the factors concerned the term of measurement and the year of research. The tuber yield depended significantly on the production system and the year. No significance was found in terms of the yielding of individual varieties. Significant interactions were found for the production system and year of research (Table 4).

The influence of the production system, variety and year on the value of SPAD

The range of the SPAD values varied depending on the production system and variety, from 36.1 to 45.4 (on average for the research year). The plants grown under the organic system were characterized by a significantly lower SPAD index value compared to the plants grown under the conventional system. The value of this indicator was 39.0 and 42.7, respectively. Significant varietal differences were also found. On average, for both production systems, the varieties Tacja and Justa had the lowest greenness index, and the variety Laskara had the highest. The highest decrease in leaf greenness in relation to the conventional system was recorded in the varieties Lech and Tacja (Table 5).

Many factors influence the value of the SPAD index. These are mainly fertilization, a variety, weather conditions, and the type of soil. The large variability of the SPAD value has been confirmed by many researchers

Table 4

The significance of the studied factors

Tested parameter	*F*	*p*
SPAD		
Production system	21.19	0.0000**
Variety	6.0	0.0000**
Date of measurement	3.23	0.0000**
Maturity group	14.57	0.0000**
Year	2.28	0.0000**
Variety x year	2.77	0.000*
Date of measurement x year	1.91	0.011*
Variety x production system	0.49	ns
Variety x date of measurement	0.49	ns
Production system x year	0.13	ns
Production system x maturity group	0.33	ns
Maturity group x date of measurement	0.38	ns
Maturity group x year	0.56	ns
Tuber yield		
Production system	107.9	0.0000**
Variety	1.3	0.313
Year	16.2	0.000*
Variety x production system	0.7	0.647
Variety x year	0.5	0.870
Production system x year	5.9	0.014*

* significant at α=0.05, ** significant at α=0.01, ns – not significant

Table 5

SPAD index in relation to crop production system, variety and maturity group (2017-2019)

Production system							
organic				conventional			
39.0*a*				42.7*b*			
Variety							
Tacja	Lech	Justa	Otolia	Lawenda	Mazur	Magnolia	Laskara
38.4*ab*	39.9*b*	38.5*ab*	40.8*bc*	41.6*c*	42.9*cd*	43.4*cd*	44.4*d*
Maturity group							
very early		early			mid early		
38.4*a*		42.5*b*			42.0*b*		

a, *b*, *c* – mean values marked by the same letters are not statistically significant at the .05 level by the Tukey's test; the designations apply to all tables.

(Gianquinto et al. 2003, Michałek, Sawicka 2005, Rykaczewska 2005, Zarzyńska, Pietraszko 2017, Lombardo et al. 2020*a*). In the study by Zarzyńska, Pietraszko (2017), the range of the average SPAD index value for five measurement dates was from 37.1 to 43.9 depending on a variety (average for two production systems).

Dvorak et al. 2019 studied the content of chlorophyll in leaves of potato plants depending on the area of cultivation, fertilization and age of plants. They stated that the chlorophyll content, averaged over the measurement dates, was 47.3 for the control combination (100 kg N ha^{-1}) and that the chlorophyll content declined with the increasing age of plants in each location. The SPAD value in the range from 30 to 50 units was obtained by Rykaczewska (2005), who used different doses of nitrogen fertilization.

The maturity group of varieties influenced the SPAD value, although significant differences were only between very early varieties and the remaining ones. The very early varieties were characterized by lower leaf greenness in both production systems. However, the decrease in the value of the SPAD index in the organic system compared to the conventional system observed in this group of varieties was the lowest and equalled 5.8%. In the group of early and mid-early varieties, this decrease amounted to 7.0 and 7.3%, respectively (Table 5).

The value of the SPAD index significantly depended on the weather conditions in the year of the study. The range of the value of this indicator (on average for production systems and varieties) ranged from 35.6 to 48.1. A similar range was obtained by other researchers (Love et al. 2005, Rykaczewska 2005, Coelho et al. 2010, Zarzyńska, Pietraszko 2015, 2017). In 2017 and 2018, the SPAD indicator was at a similar level, while significantly higher values were obtained on average for varieties in 2019 (Table 6). The significance of the interaction of the varieties with the year of research was confirmed.

Table 6

SPAD index depending on variety and years of investigation (mean for production system)

Variety/Year	2017	2018	2019
Tacja	38.3*ac*	33.0*a*	43.8*bf*
Otolia	35.6*ab*	42.4*bf*	44.3*cf*
Lech	39.7*af*	36.7*ac*	43.0*bf*
Justa	37.4*ac*	39.5*ae*	38.5*ad*
Mazur	38.7*ad*	42.3*bf*	47.8*ef*
Magnolia	43.1*bf*	39.0*ad*	48.1*f*
Lawenda	39.2*ad*	41.6*bf*	43.9*bf*
Laskara	44.3*cf*	41.9*bf*	46.9*df*
Mean	39.6*A*	39.5*A*	44.5*B*

Research on the degree of nutrition of potato plants has been carried out at our Institute for many years. Studies mainly concern the assessment of plant nutrition depending on the applied nitrogen doses. The aim of the research carried out by Trawczyński (2019*a*) has been to determine the optimal nutritional status of potato plants with nitrogen in a growing season, using a chlorophyllmeter and determining the relationship between values of an NNI test and leaf greenness index SPAD measurement. These studies show that the SPAD value for the optimal nutritional status of potato plants with nitrogen in the growing season, from 28 DAE (days after emergence) to 56 DAE, determined with an optical measuring instrument Konica-Minolta SPAD 502, was 43.8 units on average. The critical value of leaf greenness indices evaluated using an N-Tester on a scale of 0-80 from the phase of crop cover in inter rows to fruit setting on plants was 43.9 for the early variety Gwiazda and the medium early variety Etiuda, and 43.7 SPAD units for the medium late variety Gustaw. With these SPAD unit values, potato plants were optimally nourished with nitrogen. Mazurczyk et al. (2002) confirmed that SPAD readings for varieties optimally nourished with nitrogen are relatively independent of the phase of their growth and development. Hence, the values of the established SPAD green leaf index test units may refer to developmental phases, from the thinning of plants in inter rows to the fruit setting on potato plants during the growing season, during which foliar fertilization of potato plants with nitrogen is justified. The results of Coelho et al. (2010) showed critical values 40.5 and 43.7 for SPAD readings, 66.7 and 75.2 g kg^{-1} for leaf N concentration, and 6.13 and 6.96 mg g^{-1} for total leaf chlorophyll content, respectively, for Agata and Asterix varieties. The SPAD reading values correlated with the values of extractable total chlorophyll in the fourth leaf and potato tuber yields at the final harvest, indicating the possibility of using SPAD measurements at 21 days after plant emergence to forecast the final potato tuber yield. Our research shows that the average SPAD value of 43.8 was not achieved for all the varieties and production systems in the entire growing season. On average, for the dates of measurement, threshold SPAD values were obtained by the varieties Mazur, Magnolia and Laskara grown in the conventional system. In the organic system, none of the varieties obtained such a value. The level of soil moisture has great influence on the SPAD value. Higher SPAD values are often when there is water deficit in the soil, inducing greater concentration of chlorophyll in the cells (Boguszewska et al. 2018). This was the case in 2019, with the lowest rainfall during the growing season and the highest chlorophyll content (Table 6).

Influence of the measurement date (physiological age of plants) on the value of SPAD

In both production systems, the highest SPAD was recorded in the first measurement period, i.e. 45 days after planting. Since then, there was a steady decline in leaf greenness in both systems. The results of our research and literature data show a decrease in the SPAD index with the passage of time and advancement of the physiological age of potato plants, even when these changes are not yet visible to the human eye. In the research of Michałek and Sawicka (2005) as well as Rykaczewska (2005), the decrease in the greenness index of leaves started as soon as about 50 days after planting. In the study by Zarzyńska and Pietraszko (2015), carried out on organic and conventional systems, the decrease in the content of chlorophyll was more rapid in the organic system than in the conventional one, and started approximately 40 days after planting.

As already emphasized, the SPAD value achieves an optimal value, which according to Trawczyński (2019*a*) is 43.8, between 28 and 56 days after emergence, which more or less coincided with our measurement period. As shown in figure 1, such a value in the organic system was achieved by plants in the first measurement period, i.e. 45 days after planting, and the value of this indicator was lower on later dates. In the conventional system, the SPAD value was higher on the first two measurement dates, i.e. 45 and 55 days after planting. The decrease below this value began 65 days after planting (Figure 1).

The response of varieties from different maturity groups was varied. In the organic system, the very early varieties did not achieve a SPAD value of 43.8 at all. Early and mid-early varieties maintained this value up to 55 days after planting (Figure 2). In the conventional system, very early

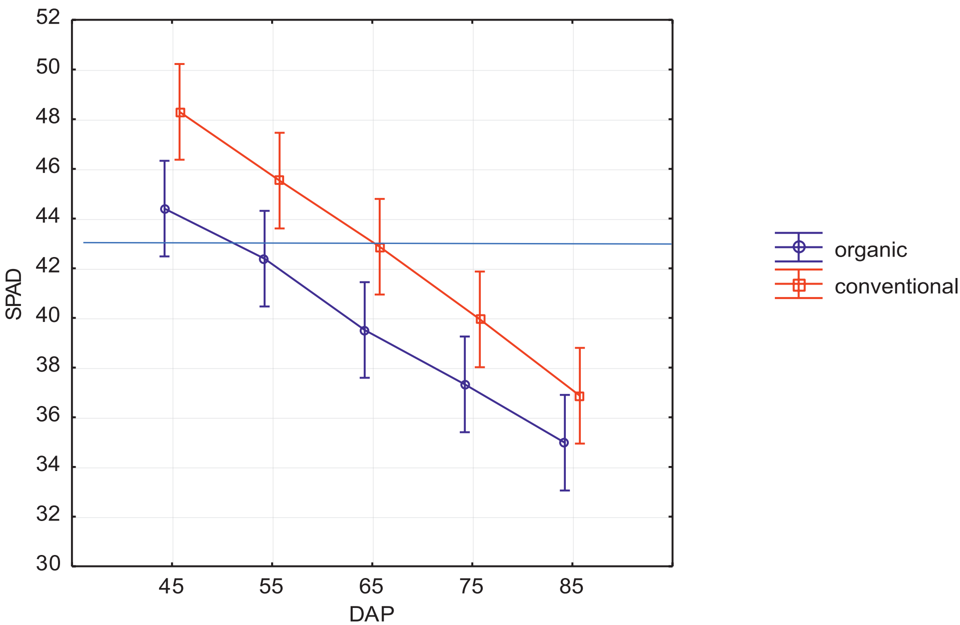

Fig. 1. Changes in the value of the SPAD index in the organic and conventional system during the growing season (mean for varieties and years)

The horizontal line in the figure indicates the optimal SPAD value

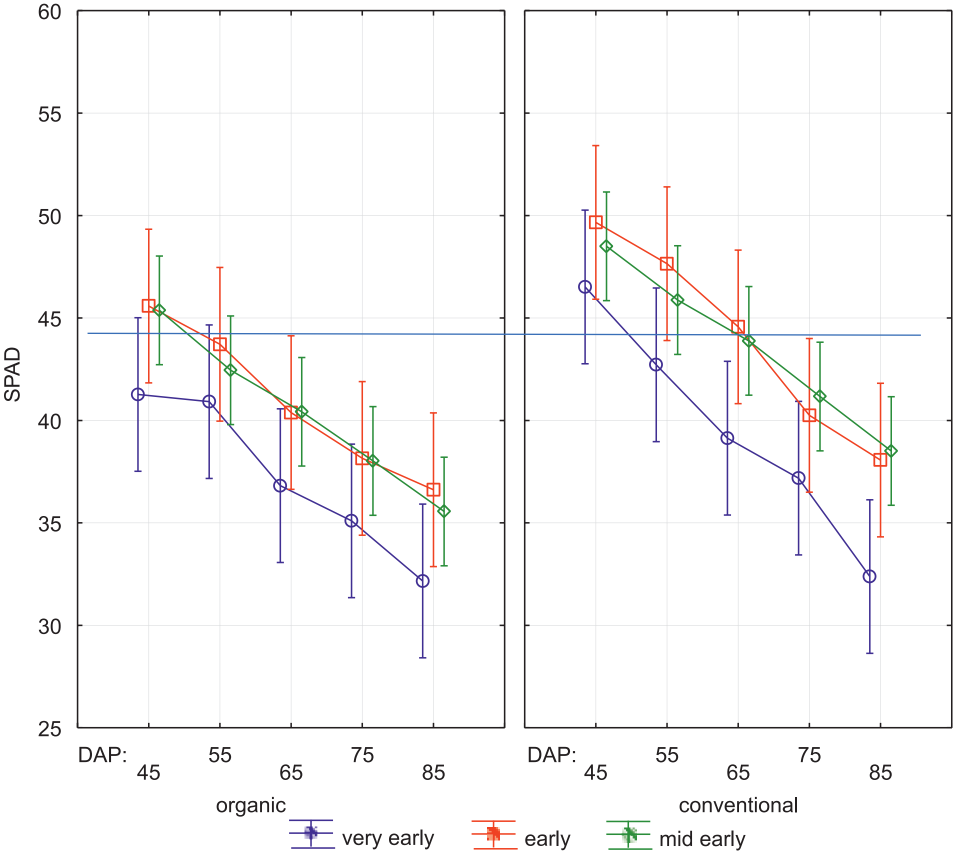

Fig. 2. Changes in the value of the SPAD index in the organic and conventional system in the period of vegetation for different maturity groups of varieties (mean for the years)

varieties maintained a SPAD value of 43.8 to day 55 after planting, and early and mid-early varieties – up to 65 days after planting (Figure 2).

These data show that plants of very early varieties in the organic system should be supplied with nitrogen right after the rows are closed, but this is theoretical information because, as we know, very early varieties have a short growing season and additional nitrogen fertilization often means that they are not able to utilize it and nitrogen remains in the form of nitrates. This situation, especially in organic production, should not take place. Also in the conventional system, very early varieties are rarely supplied with N. According to the data obtained, early and mid-early varieties should be fertilized 55 days after planting. In the conventional system, early varieties should be fertilized with a supplemental dose of nitrogen 65 days after planting. Tuber yield depends on the examined factors.

The yield of tubers obtained in the organic system was 44.5% lower than in the conventional system and amounted to 27.0 and 48.7 t ha^{-1}, respectively.

There were no significant interactions of varieties with the production system. Certain bans or major restrictions on the use of chemical and fertilizer inputs in the organic production system resulted in weaker plant growth, and consequently reduced tuber yield and size. The literature informs about a decrease in the potato yield between the organic and conventional systems in the range from 10 to 70% in favour of the conventional system (Sawicka, Kuś 2000, Guler 2010, Ierna, Parisi 2014, Zarzyńska, Pietraszko 2017). On the other hand, the differences in the yield in each year of the research depending on the production system were found to be significant. On average, for both systems, the highest yield was obtained in 2017. In the organic system, no significant differences in the yield were found between individual years, but in the conventional system, a significantly higher yield was obtained in 2017 (Table 7). Undoubtedly, the differences in yields resulted

Table 7

Tuber yield (t ha^{-1}) depending on the production system and year

Year/Production system	Organic	Conventional	Mean
2017	30.1*a*	62.7*c*	46.4*B*
2018	20.5*a*	42.2*b*	31.4*A*
2019	29.1*a*	43.3*b*	36.2*A*
Mean	27.0*A*	48,7*B*	

from the amount of rainfall in years. The highest rainfall was recorded in 2017 (Table 2), and in that year the yield was the highest in both production systems. The differences in the level of precipitation in 2018 and 2019 were much smaller (Table 2), and so were the differences in the yields. This mainly concerned the conventional system (Table 7).

Therefore, we can reaffirm that so-called ‘blight years’ with high rainfall are years of high potatoes yields. This particularly applies to the conventional system, where the use of pesticides and mineral fertilizers is allowed. In organic farming, the situation is more complicated. In years with unfavourable weather conditions, the smallest potato yields can be expected for organic production systems (Zarzyńska, Pietraszko 2015, Lombardo et al. 2020*b*). The results obtained by Bilsbbrrow et al. (2013) also indicated that climatic factors may affect yields in organic systems more than in conventional systems (e.g. via their effect of the rate of N-mineralisation from organic matter).

The relationship between the value of the SPAD index and the tuber yield

A significant positive correlation was found between the value of the SPAD index and the value of tuber yield (on average from both production systems, varieties and year) – Figure 3. The correlation coefficient between

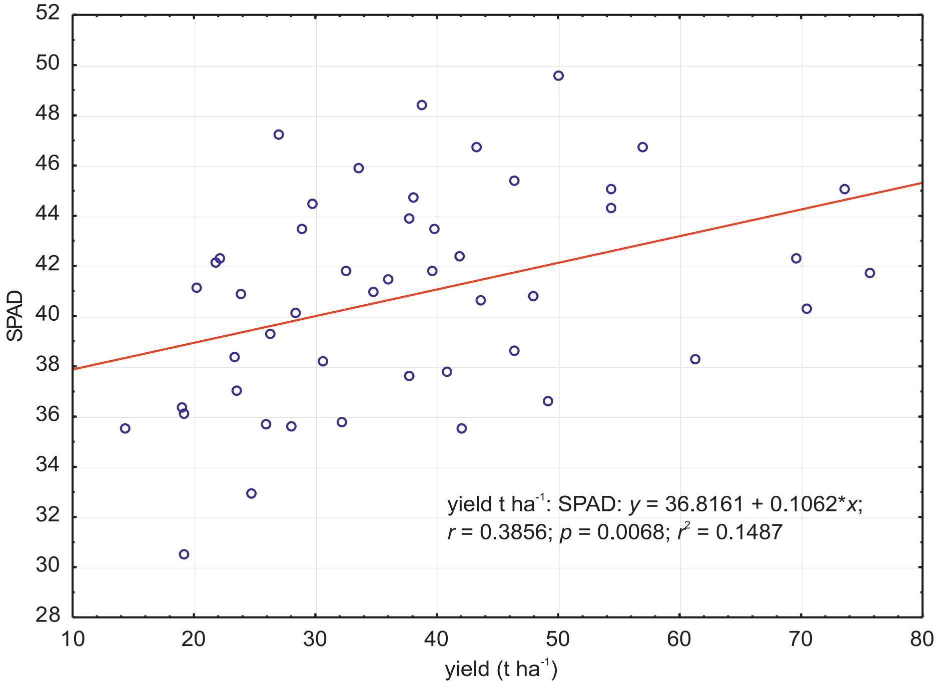

Fig. 3. Relationship between SPAD value and tuber yield for production system, varieties and years

these features was 0.3856. Such dependencies have been confirmed by many authors (GIANQUINTO et al. 2003, KUMAR et al 2007, GOFFARTt et al. 2008, COELHO et al. 2010, DVORAK, KRAL 2019). GIANQUINTO et al. (2004) showed the dependence of the SPAD levels at different sampling dates and the final yield of potato tubers in the variety Primura. The coefficient of determination ranged from $r^2 = 56.3\%$ to $r^2 = 83.5\%$ in their experiment. GULER (2010) confirmed a significant linear relationship between the leaf chlorophyll content and N applied ($R^2 = 0.91$). There were significant correlations between chlorophyll and yield and yield-related characters. Total yield significantly correlated with leaf chlorophyll. DVORAK et al. (2019) stated that the relationship between the chlorophyll content and the yield of tubers was evident (the highest yield of tubers and the highest SPAD values). Likewise, this was expressed by the correlation coefficient (r=0.5363, r^2=28.8%, p=0.0023). ZARZYŃSKA and PIETRASZKO (2015, 2017) also showed that the higher the SPAD index, the higher the tuber yield, regardless of a production system.

Our previous research showed that the production system affects the content of both macro- and micronutrients in potato tubers. In the organic system, most of these elements are generally more abundant than in the conventional system. The exception is nitrogen, the content of which cultivation is always lower in tubers from organic fields.

Table 8

The content of macro- and micronutrients in potato tubers grown in the organic and conventional system (Jadwisin, 2011-2013)

Production system	macronutrients (% dry weight)				
	nitrogen	phosphorus	potassium	magnesium	calcium
Organic	1.13*a*	0.32*b*	2.06*b*	0.13*b*	0.05*a*
Conventional	1.19*b*	0.26*a*	1.69*a*	0.11*a*	0.05*a*
	micronutrient (mg kg^{-1} dry weight)				
	copper	iron	manganese	zinc	bor
Organic	5.5*b*	4.4*b*	6.6*a*	14.1*b*	5.2*a*
Conventional	4.3*a*	40.7*a*	6.6*a*	13.5*a*	5.2*a*

The content of basic macro- and micro elements in potato tubers from the two production systems is shown in Table 8. The greatest differences in favour of the organic system occurred in the content of phosphorus, potassium, and magnesium, as well as copper, iron and zinc.

CONCLUSIONS

The value of the SPAD index depended on all the examined factors, i.e. production system, variety, maturity group, year and the date of measurement. In both production systems, the highest leaf greenness index was obtained in the first measurement period, i.e. approx. 45 DAP. In the organic system, the optimal SPAD value of 43.8 was achieved by plants only in the first measurement period, i.e. 45 DAP. In the conventional system, this value was maintained up to 65 DAP.

The response of varieties from different maturity groups was diversified. The very early varieties grown under the organic system did not achieve a SPAD value of 43.8 at all. The mid-early and early varieties kept this value up to 55 DAP. In the conventional system, very early varieties maintained this value until 55 DAP, and early and mid-early varieties up to 65 DAP.

The tuber yield in the organic system was 44.5% lower than in the conventional system. A significant positive correlation was found between the SPAD value and the tuber yield.

The research data can be used to develop a model of feeding potato varieties from different maturity groups cultivated in different production systems.

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