



Short Communication

Response of Surface Mulching of Potato (*Solanum tuberosum*) on SPAD Value, Colorado Potato Beetle and Tuber Yield

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Abstract

Effects of surface mulching on the SPAD values, Colorado potato beetle and yield of ware potatoes were studied in three years (2009-2011). Increased production of tubers was assured by the use of grass mulch compared with variant without mulch (from the perspective of optimal production can be recommended of grass mulch before full germination). This application is characterized by a lower incidence of Colorado potato beetle larvae and higher yield of tubers by 3.2% comparison with application immediately after planting. Grass mulch also affected the SPAD readings. Yield of ware potatoes significantly correlated with SPAD readings of mulching plants – grass mulch after planting ($r^2 = 53.7\%$), grass mulch before full germination ($r^2 = 41.6\%$) and mulch textile ($r^2 = 54.6\%$). © 2013 Friends Science Publishers

Keywords: Grass mulch; Chlorophyll; SPAD; Potato; Yield

Introduction

Potatoes as well as other wide-crops are associated with water erosion. The principle is in targeted use of biomass in the period when main crop does not protect the soil surface. We can use protective functions of intercrops and crop residues left on the soil surface (Cheema *et al.*, 2004; Novák *et al.*, 2011) or mulch applied to the soil surface. The SPAD-502 is an easy, portable tool that measures the greenness or relative chlorophyll content of leaves (Busato *et al.*, 2010). The correlation content of chlorophyll with content of N in the laboratory conditions was published already Vos and Born (1993) - for potatoes with the result $r^2 > 0.95$. In field trials Uddling *et al.* (2007) shows a lower dependence and only $r^2 > 0.58$.

This study was focused on the effect of various mulching materials (organic and plastic mulch) on the nitrogen status, incidence of Colorado potato beetle and tuber yield of ware potatoes.

Materials and Methods

Field experiments were carried out at two sites in years 2009-2011 (Table 1). Three mulch treatments were used in randomized block design with four replicates and plot size 7.2 m². Pre-sprouted seed tubers were hand-planted.

The mulching with chopped grass (GM) and black textile mulch (BTM) were compared to non-mulching control variant (C) with mechanical cultivation. Grass mulch was spread manually in a 25-mm thick layer firstly

after planting (GM1) and secondly before full germination (GM2). In plots with BTM ridges were formed firstly and then covered by the black polypropylene non-woven textile and subsequently hand planted.

The SPAD values were measured in the second fully expanded leaf from the apex (with the SPAD-502 portable chlorophyll meter at the same plants) from full plant emergence to the end of vegetation. The SPAD values were correlated also with yield of ware potatoes for each mulch treatments.

The evaluation of the rate of larvae of the Colorado potato beetle (CPB) was done at 7-10 days intervals since the first appearance to removal of potato haulm in accordance with the procedure Dvořák *et al.* (2012).

Tubers were harvested by hand. Yield of ware potatoes (tubers >40 mm) was determined for each plot.

The GLM procedure and correlation was used with SAS ver. 9.1.3. Tukey's test was used only when the ANOVA F-test showed significant at 0.05 probability level. Linear regression was performed on data between yield of ware potatoes and SPAD, yield of ware potatoes and CPB larvae.

Results

The potato plants with GM1 and GM2 were characterized by higher SPAD values (by 4.5% and 3.4%) compared with C (Table 2). The increased SPAD values (Fig. 1) respectively, higher N content in plants affected the tuber yield.

Table 1: The characteristics of experimental sites

Station	GPS	Altitude	Annual Temperature (°C)	Annual Precipitation (mm)
Leškovice	49°45'46"N, 15°32'16"E	498 m a.s.l.	6.9	630
Uhřetěves	50°2'0.4"N, 14°36'32"E	298 m a.s.l.	8.4	575

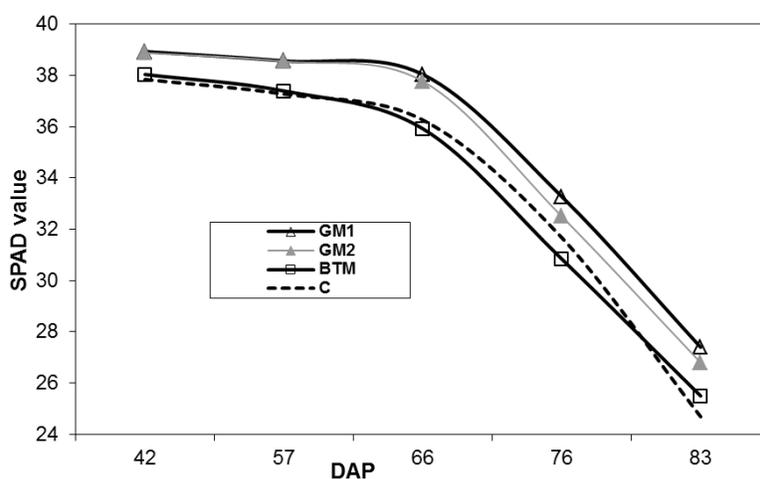
Table 2: SPAD values, CPB larvae and yield of ware potatoes in crops with different types of mulching materials (on average sites and years)

Parameter/mulch treatment	C	GM1	GM2	BTM
SPAD values	35.6 a	37.2 c	36.8 bc	35.8 ab
CPB larvae (No per 10 plants)	20.2 a	14.2 b	13.6 b	26.9 c
Yield of ware potatoes (t/ha)	30.1 a	36.6 b	37.8 b	29.2 a

Note: same letters indicate statistically not significant averages; LSD_{0.05} (SPAD) = 0.991, LSD_{0.05} (CPB larvae) = 5.596, LSD_{0.05} (Yield of ware potatoes) = 2.908

Table 3: Correlation dependence of yield of ware potatoes and SPAD values, yield of ware potatoes and CPB larvae for each type of mulching

Parameters	/mulch treatment	SPAD	CPB larvae
Yield of ware potatoes	C	0.532 $p \leq 0.001$	-0.128 <i>ns</i>
	GM1	0.733 $p \leq 0.0001$	-0.135 <i>ns</i>
	GM2	0.645 $p \leq 0.0001$	-0.311 $p \leq 0.05$
	BTM	0.739 $p \leq 0.0001$	-0.399 $p \leq 0.01$

**Fig. 1:** The evolution of SPAD values on plots with GM1, GM2, BTM and C treatments

The type of mulch material and term of its application affected the yield of ware potatoes (Table 2). The highest yield of ware potatoes was found when using plant mulch (GM1 and GM2). Yield of ware potatoes after application of mulch were higher by 6.5 t/ha at GM1 and by 7.7 t/ha at GM2 compared with C (30.1 t/ha). BTM unlike GM had not clearly a positive effect on tuber yield for the years 2009-2011 (Table 2).

Discussion

Mulching can improve soil nitrogen availability and increase plant growth (Fang *et al.*, 2011; Younis *et al.*, 2012). For the chlorophyll content of potato leaves were demonstrated that leaf N and chlorophyll concentration are

strongly correlated, therefore it been used as an indirect indicator of plant N status (Olfs *et al.*, 2005).

We suppose that GM has created better conditions for the N availability in the soil because SPAD values in the leaves were higher by 4.5% (GM1) and 3.4% (GM2). Gianquinto *et al.* (2004) also shows the dependence of the SPAD levels at different sampling dates and the final yield of potato tubers in the variety Primura. This coefficient of determination ranged from $r^2 = 56.3\%$ to $r^2 = 83.5\%$ in their experiments. This is evident also on the correlation (Table 3), which we observed for SPAD values and yield of ware potatoes with GM1 ($r^2 = 53.7\%$) and GM2 ($r^2 = 41.6\%$).

Also Momirovic *et al.* (1997) mentioned increase in the yield by 10 t/ha in connection with the mulching potatoes. We believe that the lower yield of potato tubers by

7.4 t/ha at BTM compared with GM1 (Table 2) was due to lower availability of N in the soil, when BTM was used (compared with GM1) and further supported by less favorable conditions for growth tubers due to the highest incidence of the Colorado potato beetle larvae (Table 2) and the high defoliation of haulm. It also shows a negative moderate correlation CPB larvae and yield of ware potatoes at BTM ($r^2 = 15.9\%$).

When using the BTM is necessary to ensure consistent treatment against Colorado potato beetle (especially in warmer areas such as the Uhřetěves (Table 1), otherwise there is a decrease in yield of potato tubers.

Acknowledgements

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