BLACK POLYPROPYLENE MULCH TEXTILE IN ORGANIC AGRICULTURE

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In the organic system black polyethylene mulch is often used for weed control in a range of crops. However, using of black polypropylene mulch is usually restricted to perennial crops. In this experiment black polypropylene woven mulch was tested in potatoes under the organic system and using of mulch was compared with bare soil. The trial with two varieties of early potatoes Finka and Katka was conducted at the Experimental station of Department of Crop Production of the Czech University of Life Science Prague-Uhříněves in the Czech Republic. The result showed that the black polypropylene textile had a positive effect on soil temperature (in the depth of 100 mm). After planting slightly higher soil temperatures under black polypropylene mulch had a favourable influence on earlier stands emergence of potatoes. On an average of vegetation period soil water potential (in the depth of 250 mm) and also soil water content was higher under black polypropylene mulch than in control treatment. However, after planting as well as at the end of vegetation lower values of soil water potentials were found out under black polypropylene mulch. Black polypropylene mulch provided favourable temperatures and soil moisture for potatoes. Post harvest analyses were focused on the determination of the yield and the quality of tubers from each variant.

***Key words**: black polypropylene textile, potato, yield, quality, microclimate*

Black polyethylene mulches are used for weed control in a range of crops under the organic system. However, using of black polypropylene woven mulch is usually restricted to perennial crops. For weed control in the field various colours of woven and solid film plastics have been tested [HOROWITZ, 1993]. Whereas white and green covering had a small effect on weeds, brown, black, blue or white on black (double colour) films prevented weeds emerging [BOND and GRUNDY, 2001]. Using of mulches has additional environmental benefits on condition that mulch is made from recycled materials [COOKE, 1996]. The aim of this research was to find favourable growing procedure for potatoes in organic agriculture. Foil

or black mulching textile reduce weed biomass, increase soil temperature and soil water content, but their application in praxis is difficult.

MATERIAL AND METHOD

The trial under organic system was conducted at the Experimental station of Department of Crop Production of the Czech University of Life Science Prague-Uhříněves in 2008. The altitude of the site is 295 m a.s.l., the average of annual temperature is 8.4 °C and annual precipitation is 575 mm (detailed information *Table 1*). The type of soil is brown soil with high nutrient reserve. Texture class of soil is clay loam. Organic matter content is 1.74 – 2.12 %.

In the experiment with two varieties of early potatoes Finka and Katka the black polypropylene non-woven textile and mechanically cultivated control treatment without mulching (bare soil) were compared. In the variant with mulch formed ridges were covered by the black polypropylene non-woven textile before planting. During the hand-planting potatoe tubers were set to prepared holes in the textile deployed to a demanded spacing (450 mm x 800 mm).All treatments were diveded into four parallel determinations (plot trials 7.2 m^2).

Table 1

Temperature and precipitation in experimental periods and longterm average

Longterm average	Month										
	I	II	III	IV	V	VI	VII	VIII	X	XI	XII
Air Temperature (°C)	-2.1	-0.8	3.4	8.2	13.4	16.3	18.2	17.5	8.6	3.2	-0.5
Precipitation (mm)	28	27	31	46	65	74	74	72	41	34	34

Post harvest analyses were focused on the determination of the yield and quality of tubers from each variant. Summary statistics of the effect of mulching and variety on weed-infestation rate and tubers yield were obtained by using Statgrafic Plus 5.1. Statistical analyses were performed by using the ANOVA. Means were compared by using Tukey test at the level of significance $\alpha = 0.05$.

RESULTS AND DISCUSSIONS

Soil temperature and soil water potential

Using of the black polypropylene textile (BPT) in potato stand did not influence soil temperature in the depth of 100 mm (*Table 2*). Even though in some periods the soil temperature was higher under the BPT in comparison with control variant (bare soil), on an average of vegetation term (IV. – VIII.) the soil temperature below the BPT was lower only about 0.1 °C.

These results are in accordance with findings of OSSOM and MATSENJWA [2007], who detected higher soil temperatures (in the depth of 100 mm) in non-mulched variant than in variant covered by a black polythene foil.

In this experiment slightly higher soil temperatures under the BPT were measured after planting, which leaded to the earlier stands emergence of potatoes in variant with the BPT than in control treatment (bare soil).

Weed control

The BPT had a positive effect on the weight of weed biomass (*Figure 1*). In comparison with mechanically cultivated control variant (bare soil), the weight of weed biomass was reduced by 89 % in black polypropylene textile mulch.

Table 2

Soil temperature (°C) and soil water potential (kPa) on an average of month in Prague-Uhříněves in vegetation period 2008

Month	Soil Temperature (°C)		Soil Water Potential (kPa)	
	Bare soil	Black polypropylene textile	Bare soil	Black polypropylene textile
IV	12.4	12.5	5.7	4.9
V	15.9	15.6	25.8	21.4
VI	18.2	18.0	69.3	66.7
VII	19.2	19.3	44.0	37.5
VIII	23.0	22.8	61.2	33.3
Average	17.7	17.6	41.2	32.8

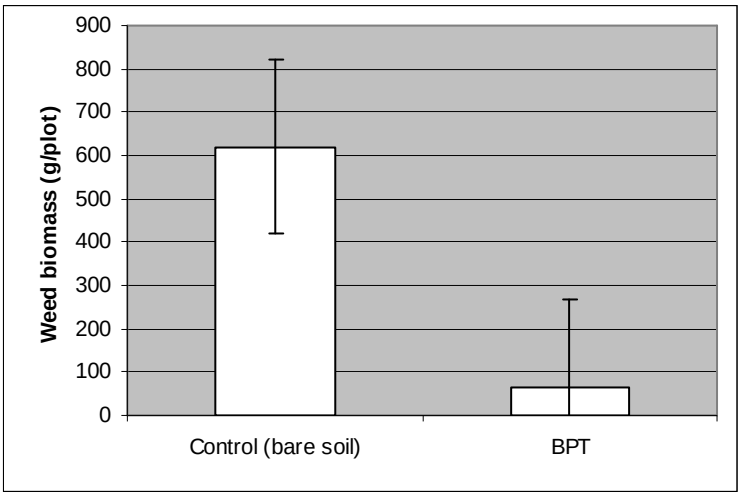

Figure 1 **The effect of the BPT on the weight of weed biomass (on average of varieties**)

Yield and quality of tubers

The result showed that mulching by the BPT did not affect the number of tubers (*Table 3*). Also the higher number of ware potatoes was found out in control variant without mulch (bare soil), however, the increment was statistically insignificant.

Results from precise field experiments also did not proved a significantly positive effect of the BPT on the yield of ware potatoes (*Table 3*). In the variant with the BPT the yield of ware potatoes was lower by 1.4 t/ha than in control treatment without mulch (bare soil), however, the reduction of the yield was insignificant. Results also showed a positive effect of the BPT mulch on the quality of ware potatoes (*Table 4*). Tubers cultivated under the BPT had higher ascorbic

acid content (by 13.3 %), higher content of chlorogenic acid (by 37.2 %) and lower glycoalkaloids content (by 8.8 %) than tubers cultivated without mulch (bare soil).

Table 3

The effect of BPT on the number and yield of ware potatoes (on average of varieties

Variant	Number of tubers (No. per plot)	$HSD_{0.05}$	Number of ware potatoes (No. per plot)	$HSD_{0.05}$	Yield of ware potatoes (t/ha)	$HSD_{0.05}$
Bare soil	158.8^{n}	22.79	81.6^{n}	13.85	25.4^{n}	7.701
BPT	144.1^{n}		75.4^{n}		24.0^{n}	
Difference	14.7		6.2		1.4	
Notes: statisticallz significant difference – α =0.05 (*); statistically insignificant (^{n})						

Table 4

The quality of tubers cultivated under the black polypropylene textile mulch and wihout mulch (bare soil)

Variant	Variety	Ascorbic acid	Chlorogenic acid	Glycoalkaloids
Bare soil	Finka	99.0	68.2	30.5
	Katka	107.4	167.5	156.2
	average	103.2	117.9	93.3
BPT	Finka	132.2	128.7	57.9
	Katka	101.6	194.6	112.3
	average	116.9	161.7	85.1
Difference (Bare soil – BPT)		-13.7	-43.8	8.2

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CONCLUSIONS

Using of the black polypropylene textile had a positive effect on soil temperature after planting, which leaded to earlier stands emergence of potatoes than in control treatment. The black polypropylene textile also reduced soil water potential (on average by 8.4 kPa than in control variant without mulch), which can result in lower irrigation requirements.

Mulching potatoes by the black polypropylene textile did not affect the yield and number of ware potatoes, however, results proved a positive effect of the black polypropylene textile on the quality of potatoes. Using of the black polypropylene textile also decreased significantly biomass of weeds (by 89 %) in comparison with control variant without mulch. It occures a possibility of widespread using of black polypropylene mulch in the system of organic farming.

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