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PRELIMINARY COMMUNICATION

Ecological growing of potatoes with using of grass mulch and black textile mulch

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Abstract

The aim of the experiment was to evaluate the effect of different mulch materials on the occurrence of Colorado Potato Beetle, weed biomass and especially on the yield of ware potatoes. The experiment with different types of mulching (grass mulch, black textile mulch, non-mulched control) and 2 varieties (Finka and Katka) was carried out under organic system in 2009. The results showed that the grass mulch was the best mulching material for reaching the highest yield, where an increase of the yield of ware tubers by 6.6 - 7.8 t/ha in comparison with non-mulched control variant was observed. In the experiment the mulching of organic potatoes had a positive effect on a lower activity of an oviposition of Colorado Potato Beetle and a consecutive occurrence larvae by the variant with the grass mulch, a lower weed infestation by the variant with the black mulch textile in comparison with non-mulched control.

Key words: organic farming, potato, grass mulch, textile mulch, yield

Introduction

Covering or mulching the soil surface can prevent weed seed germination or physically suppress seedling emergence, but it is not effective against established perennial weeds. The mulch may take many forms: a living plant ground cover, loose particles of organic or inorganic matter, plant residues from preceding crops and different plastic sheeting laid along the planted row. Loose materials like straw, bark and composted municipal green waste can provide an effective weed control, but the depth of mulch needed to suppress weed emergence is likely to make transposition cost prohibitive unless the material is produced on the farm (Merwin et al., 1995).

Black polyethylene mulches are used for weed control in a range of crops under the organic system. The use of black polypropylene woven mulch is usually restricted to perennial crops. Various colours of woven and solid film plastics have been tested for weed control in the field (Horowitz, 1993). White and green covering had a little effect on weeds, whereas brown, black, blue or white on black (double color) films prevented weeds emerging (Bond and Grundy, 2001). There are additional environmental benefits if the mulch is made from recycled materials (Cooke, 1996).

As different experiments and studies show, effects of organic mulches on the yield of potatoes have been variable. This variance is attributed mainly to differences in climatic conditions.

While the yield increase through straw mulch was frequently found under hot and dry summer conditions (Bushnell and Welton, 1931; Singh et al., 1987), reduced yields under straw mulch have also been reported and were attributed to below-optimum soil temperature (Opitz, 1948), reduced soil nitrate levels (Scott, 1921) and too early mulching (Bushnell and Welton, 1931). Increasing of the quantity of applied mulch intensifies the effects on soil moisture and temperature (Scott, 1921; Russel, 1940); therefore, large

application rates (10 t/ha and more), which were common in past studies and practice; appear to increase the risk of yield reduction in cooler climates.

The aim of this study was to evaluate the influence of mulching on the yield of ware potatoes, tuber size fractions distribution, the weight of weed biomass and the occurrence of Colorado Potato Beetle.

Material and methods

The trial was conducted in 2009 at the Experimental station of Department of Crop Production of the Czech University of Life Science Prague-Uhřetěves (sugar beet growing region, 295 m a.s.l., average of annual temperature 8.4 °C and annual precipitation 575 mm). Clay-loam cambisol has topsoil deep 250-300 mm, with neutral pH, organic matter content 1.74 - 2.12 %.

The experimental station Uhřetěves is certified for the conductance of experiments in organic agriculture.

For the experiments, two pre-germination varieties of early potatoes Finka and Katka were used in different types of mulching (GM1 - grass mulch after planting, GM2 - grass mulch after second hoeing, BTM - black textile mulch) and in the mechanically cultivated control variant without mulch (C). All variants were provided in four parallel determinations.

During vegetation the occurrence of Colorado Potato Beetle and the weight of weed biomass were observed in all experimental variants.

After hand harvest (104 days after planting) was stated the yield of potatoes from each variant, then tubers were sorted out into four fractions (<40, 40-54, 55-60 and >60 mm) and the weight of all fractions was ascertained.

Summary statistics of the effect of mulching on weed-infestation rate, the activity of oviposition of Colorado Potato Beetle and tubers yield were obtained using Statgrafic Plus 5.1. Statistical analyses were performed using the ANOVA. Means were compared using Tukey test on the level of significance $\alpha = 0.05$.

Results and discussion

The results showed that mulching had affected the yield of ware potatoes, tuber size fractions distribution and some negative yield-forming factors (weeds and pest).

The occurrence of Colorado Potato Beetle

The experiment showed that the application of black textile mulch (BTM) increased the occurrence of Colorado Potato beetles. In this variant earlier beetle invasion, and consequently significantly higher number of cluster of eggs and larvae were observed in comparison with other variants (Table 1). It resulted in the significantly lowest yield (24.9 t/ha) from all experimental variants (Graph 1).

Table 1 The number of beetles, eggs and larvae on 10 plants in period from May 26th to June 30th 2009 (on average of varieties)

Variants of mulching	Beetles	Cluster of eggs	Larvae
Without mulch (C)	1.6 a	7.3 a	26.9 ab
BTM	2.9 b	10.1 b	42.2 a
GM1	2.0 ab	4.6 c	13.5 b
GM2	2.1 ab	5.4 bc	13.3 b

Note: means with same letter are not significantly different ($P \geq 0.05$)

These results correspond to Döring et al. (2006), who studied the effect of different mulch materials on the occurrence of Colorado Potato Beetle in tomatoes. In the study milled peavine and black plastic mulch were compared. Variants with the foil were approximately two times more attacked by Colorado Potato Beetle than variants with organic peavine mulch and as a result of higher beetle invasion 19% yield losses were observed.

The effect on weed infestation

The application of black textile mulch (BTM) significantly reduced the weight of weed biomass (Table 2) in comparison with variants, where grass mulch was applied (GM1 and GM2). The same tendency was observed when BTM was compared with mechanically cultivated control variant (without mulch).

Table 2 The weight of weed biomass before harvest (on average of varieties)

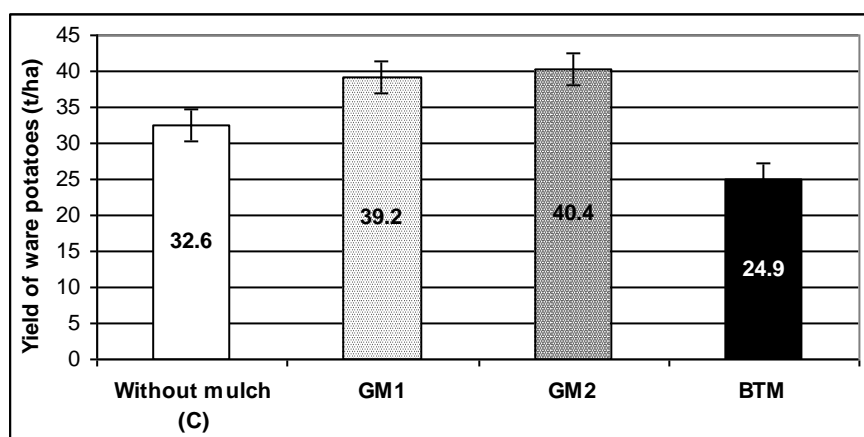
Variants of mulching	Weed biomass (g per plot)
Without mulch (C)	77.6 ab
BTM	0.40 a
GM1	152.9 b
GM2	150.7 b

Note: means with same letter are not significantly different ($P \geq 0.05$)

The effect on tuber yields and tuber size fractions distribution

The results from precise field experiments proved a significantly positive effect of grass mulch applied after planting (GM1) and after second hoeing (GM2) on the yield of ware potatoes (Graph 1). The yield of ware potatoes in variants with GM1 and GM2 were significantly higher by 6.6 t/ha and 7.8 t/ha in comparison with control variant (C).

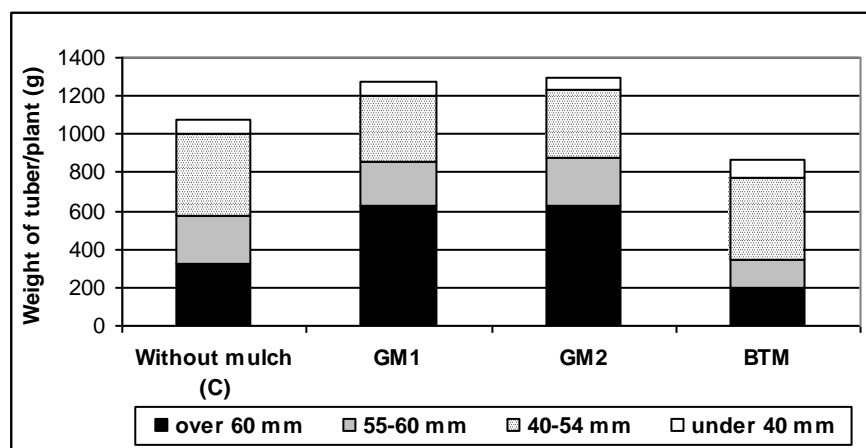
The significantly lowest yield of ware potatoes was observed in variant with black textile mulch (BTM). The yield losses in BTM were probably caused mainly by larvae of Colorado Potato Beetle invasion, which was the highest from all experimental variants.



Graph 1 The effect of mulching on the yield of ware potatoes (on average of varieties)

The results of tuber size fractions distribution showed that the highest weight proportion of tuber size fractions over 60 mm and 55-60 mm were found out in the variants with grass mulch (GM1 and GM2), whereas the lowest weight proportion of these fractions were measured in black textile mulch (Graph 2). The yield differences among variants were

affected mainly by the tuber size fraction over 60 mm, when higher proportion of this fraction increased the yield.



Graph 2 Effect of mulching on the tuber size fractions distribution under the hill (on average of varieties)

Conclusions

The experiment proved that the mulching can affect the yield of ware potatoes as well as the quantity of weed biomass and the rate of Colorado Potato Beetle invasion. From the yield point of view grass mulch was the best mulch material, when variants with grass mulch (GM1 and GM2) significantly increased the yield of ware potatoes by 20.3 % and 23.9 % in comparison with non-mulched control.

The grass mulching of organic potatoes had a positive effect on a lower activity of oviposition of Colorado Potato Beetle and a consecutive occurrence larvae, whereas the application of black textile mulch (BTM) significantly increased the occurrence of Colorado Potato beetles that caused the significant reduction of the yield of ware potatoes. On the other hand the application of black textile mulch (BTM) significantly decreased the weight of weeds biomass in comparison with all experimental variant (grass mulches - GM1 and GM2 and mechanically cultivated non-mulched control).

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