Study on the effect of mulching on potato production in organic farming

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Abstract
The experiment with different types of mulching (grass mulch, black-polypropylene-textiled mulch), 2 row spacing (28 000 and 38 000 tubers per hectare) and 2 varieties (Finka and Katka) in organic farming was carried out in year 2008. The results showed that the yield was influenced by growth structure (4.9 %), by variety (39.2 %) and by mulching (55.9 %). The grass mulch used after planting was the best mulching material for reaching the highest yield. The yield of this variant was increased statistically about 9.3 – 10.7 t/ha in comparison with control variant (bare soil) and black-polypropylene-woven mulch. The results from weed control showed the positive effect of mulching on weeds biomass, where lowest weight of weed biomass was found in black polypropylene woven mulch (by 89 %), second was grass mulch after planting (by 68 %) and than grass mulch after second hoeing (by 39 %) in comparison with control variant (bare soil).

Key words: organic farming, potato, 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, or 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 effective weed control, but the depth of mulch needed to suppress weed emergence is likely to make transpose cost prohibitive unless the material is produced on the farm (Merwin et al., 1995).

Organic mulches have the advantage of being biodegradable, but decomposition may result in a temporary reduction in soil mineral nitrogen. In addition, the natural phytotoxins released when organic materials decompose may not only inhibit the growing of weeds but also the crop plants (Wallace and Bellinder, 1992).

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 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).

Effects of straw mulch on tuber yield, however, have been variable, and this was mainly attributed to differences in climatic conditions. While 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 mulching too early (Bushnell and Welton, 1931). Increasing of the quantity of mulch applied increases 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.

Material and methods

The trial was conducted in year 2008 at Experimental station of Department of Crop Production of the Czech University of Life Science Prague-Uhříněves. 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. 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 %.

Table 1. Temperature and precipitation in experimental periods and longterm average

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<tr>
<th>Longterm average</th>
<th>Month</th>
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<tr>
<td>Temperature (°C)</td>
<td>-2.1</td>
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<tr>
<td>Precipitation (mm)</td>
<td>28</td>
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For the experiments, two varieties of early potatoes Finka and Katka were used in the different type of growth structure (row spacing - 800 mm and two inter-space distances of seed tubers - 370 mm and 450 mm) and different mulching (grass mulch after planting, grass mulch after second hoeing and black polypropylene woven mulch). Experiments in conventional agriculture were established for comparison, but with inter-row distance (800 mm), only with one type of inter-space distance (370 mm) and without mulching. All variant were provided in four parallel determinations.

Post harvest analyses were focused on the determination of the yields from each variant. Summary statistics of the effect of mulching, inter-space distance and variety on weed-infestation rate and yield tubers were obtained using Statgrafic Plus 5.1. Statistical analyses were performed using the ANOVA. Means were compared using Tukey test at the level of significance α = 0.05.

Results and discussion

The aim of this study was to evaluate influence of mulching on the yield, weed mass and tubers number of ware potato.
The results showed that mulching had affected the yield of ware potatoes and some of the yield-forming components. The highest number of ware potatoes was found on the plot with grass mulch and the lowest one on the plot with black polypropylene woven mulch (Graph 1).

The results from precise field experiments proved the significantly positive effect of grass mulch applied after planting on the yield of ware potatoes (Graph 2). The yield of ware potatoes from the plots with grass mulch used after planting was significant higher by 9.3 t/ha in comparison to control variant (without mulch).

The mulching reduced biomass of weed (Graph 3) in comparison with mechanically cultivated control variant (bare soil). The lowest weight of weed biomass was found in black polypropylene woven mulch (by 89 %), second was grass mulch after planting (by 68 %) and than grass mulch after second hoeing (by 39 %) in comparison with control variant (bare soil).
Conclusions
The grass used as mulch material after planting significantly increased the number of tubers and the yield of ware potatoes by 23.7 % and 36.6 %, respectively.
The black polypropylene woven mulch significantly decreased biomass of weeds by 89 % in comparison with control variant (bare soil), but without impact on potato yield increasing.

References