YIELD AND FRUIT QUALITY OF STRAWBERRY CULTIVARS UNDER DIFFERENT MULCHING SYSTEMS

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Abstract: *In our experiment two strawberry cultivars ('Joly' and 'Asia') were evaluated under organic farming conditions. The effect of three different mulching systems (black geotextile, straw, cut grass) on the fruit quality and yield were compared to the uncovered control parcel. Significant differences were found between the mulching systems in the number of fruits, size of fruits and in the yield.*

Key words*: soil covering, organic farming, Fragaria × ananassa 'Asia', Fragaria × ananassa 'Joly'*

INTRODUCTION

One of the important points of organic farming is the reduction of irrigation water use, soil protection and chemical-free weed control. These goals can be best achieved by mulching. Live vegetation, dead plant residue (e.g. straw, cut grass, compost, etc.), gravel and materials of industrial origin (e.g. black polyethylene sheet, black geotextile, paper, etc.) can be used for mulching. The mulching material has a direct effect among others on soil temperature, weed growth and can have an indirect effect on crop yields as well [1,2]. The organic mulching material also has nutritional properties and enhances soil life.

Kivijarvi et al. (2002) under organic farming conditions observed significant differences in the growth and yield of strawberries in regards of the organic and inorganic mulching material used [3]. Other researchers discovered similar differences between the soil covering materials in the cultivation of other cultures as well [4, 5, 6, 7].

In our research we compared the effect of different soil mulching methods in regards of fruit quality and yield with an uncovered control plot using two strawberry cultivars: 'Asia' and 'Joly'.

MATERIALS AND METHODS

Conditions of the research

The research were carried between 2016 and 2017 in the training garden of the Faculty of Horticulture and Rural Development of John von Neumann University, involving two strawberry cultivars ('Joly' and 'Asia') (Figure 1). The experimental area was sandy soil with very low hummus content and slightly alkaline pH.

The frigo seedlings were planted in a twin-row arrangement with a spacing of 40 + 70 cm by 30 cm at the end of March 2016. The 'Asia' frigo seedlings were category A+ (rhizome diameter: 12-15 mm) -imported from Italy- and the 'Joly' frigo seedlings were category A (rhizome diameter: 9-13 mm).

Figure 1. Strawberry cultivars involved in the experiment (from left to right: 'Asia' and 'Joly')

The soil analysis carried out prior to plantation showed that the nitrogen and potassium capacity of the sandy soil was weak, the pH was slightly alkaline and the humus content was low. Ecological farming is used in the experimental plots therefore we only apply crop-enhancing substances that can be used in organic farming. Before the plantation 30 t/ha organic fertilizer was deployed into the soil. In the year of the plantation additional nutrients were applied only after the harvest using organic fertilizers (200g/m^2 Greensoil Natural (brown coal from Dudar) and 0.4 kg/m^2 Italpollina (pelleted poultry manure)). In the second year from mid-March bimonthly supplementation (200g/m^2 Greensoil Natural and 0.4 kg/m^2 Italpollina) was performed. At the beginning of the flowering along with the organic nutrients also 40g/m^2 K_2SO_4 fertilizer was deployed.

Three types of soil coverage were used in addition to the uncovered control area: black geotextile, straw and cut grass. The black geotextile was placed onto the area prior to plantation and the other two mulching materials were applied afterwards. The straw and cut grass were continuously replaced in the vegetation approx. every month to ensure a cover the thickness of which is minimum 2-3 cm. During the flowering and maturation period the uncovered control plot was covered with straw in order to prevent soil particles from contaminating the fruit. After the harvest the cover was removed.

Fruit parameters, yield, fruit quality

The fruit parameters and yield were measured on 10 plants in 2016 and on 20 plants in 2017 per treatment. The plants were randomly selected before flowering. During the harvest period we harvested the ripe fruits every 2-3 days and then weighed the fruit (g) on a decimal accuracy scale. Based on the data, we determined the pieces of fruit per plant (pcs) and we calculated the marketable yield (g/plant).

Statistical analysis

Data were statistically analyzed using PAST v3.13 [8] software. One-way ANOVA test was applied for the comparison of means, at significance level of 0.05.

RESEARCH RESULTS

Fruit size changes in relation to soil covering method

The average fruit size of the two cultivars in the test are shown in Figures 2-3 sorted according to the soil covering methods. The size of the fruit in both years (2016: 'Joly': 8-10 g/piece; 'Asia': 10-11 g/piece; 2017: 'Joly': 13-14 g/piece 'Asia': 17-19 g/piece) was far behind the average fruit size achieved with conventional cultivation ('Joly': 22–34 g/piece; 'Asia': 28–30g/piece [9, 10]). In 2016 there was a significant difference between the control and cut grass as well as the control and straw treatments in the 'Joly' variety. Among the other treatments and in 2017 the difference was not significant.

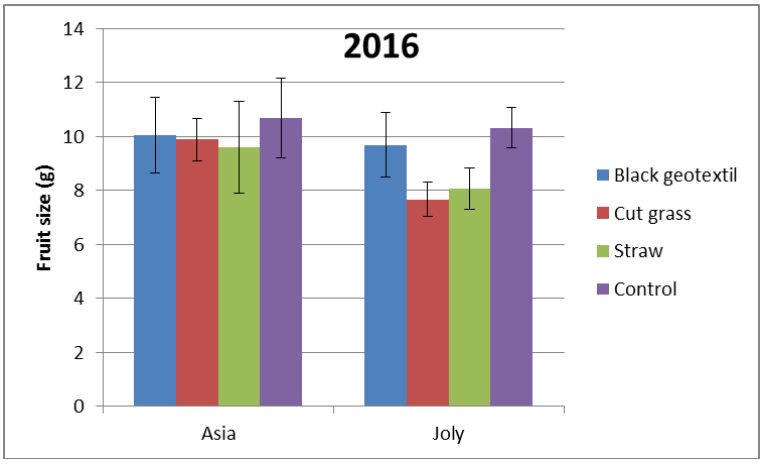

Figure 2. Average fruit size (g/pc) and standard deviation of data under organic growing conditions (Kecskemét, 2016)

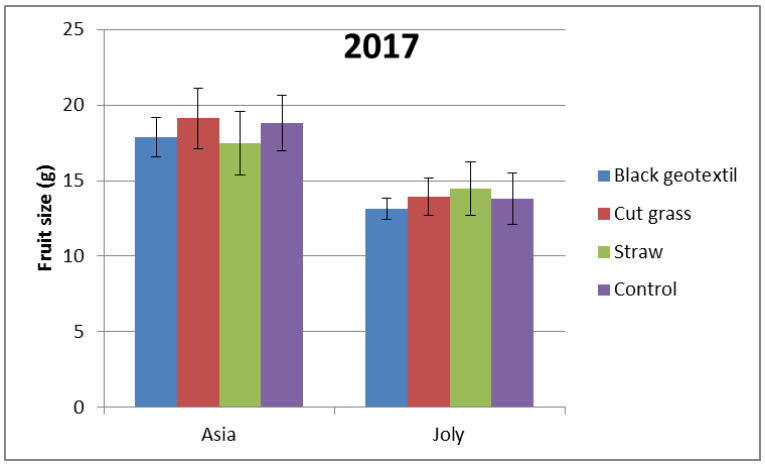

Figure 3. Average fruit size (g/pc) and standard deviation of data under organic growing conditions (Kecskemét, 2017)

Fruit number in relation to soil covering method

The average number of strawberry fruits per treatment is shown in Figures 4-5. In 2016 the average number of fruits were very low ('Joly': 4-6 pcs/plant, 'Asia': 3-7 pcs/plant), while in 2017 we could harvest a lot more marketable pieces of fruits ('Joly': 16- 22 pcs/plant, 'Asia': 20-24 pcs/plant). In 2016 a statistically valid difference was found between the cut grass – straw and cut grass – control in terms of the ‘Asia’ cultivar, and between the black geotextile – straw and straw – control treatments with regards to the ‘Joly’ cultivar. In 2017 the difference was not significant.

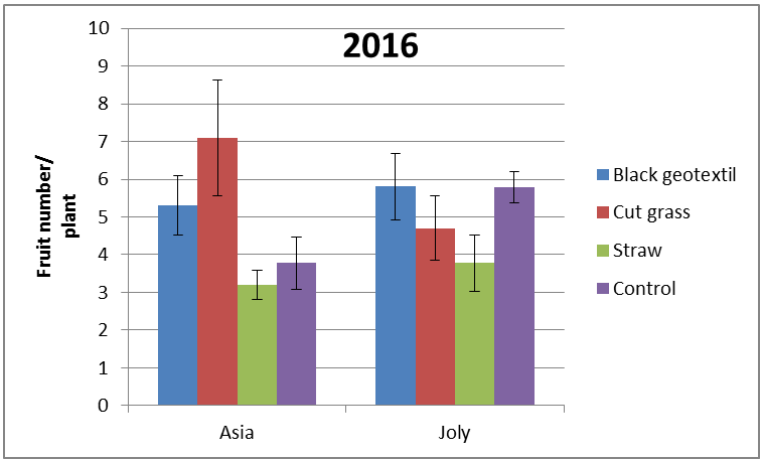

Figure 4. Average fruit number (pcs/plant) and standard deviation of data under organic growing conditions (Kecskemét, 2016)

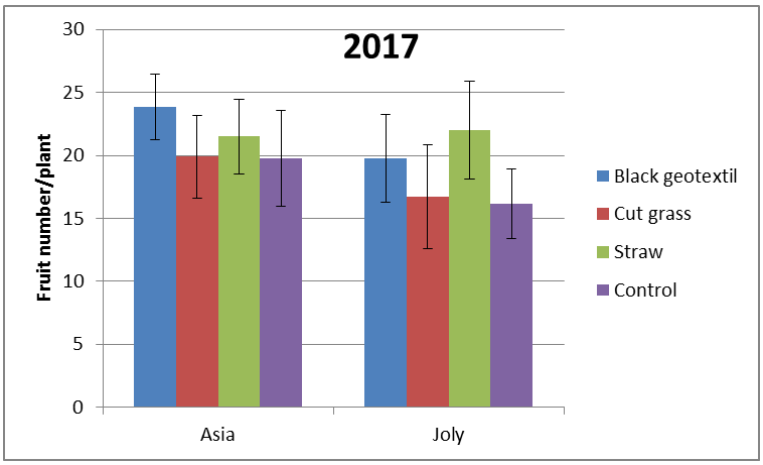

Figure 5. Average fruit number (pcs/plant) and standard deviation of data under organic growing conditions (Kecskemét, 2017)

Yield in relation to soil covering method

In 2016 (year 1) the yield (30-70 g/plant) was far behind the expected results when in bearing stage (Figure 6). Cultivation practices consider the year of installation virtually as year 0 due to the weak yield of approx. 100 g/plant. This small amount is generally not marketed, only used for own purpose or is harvested due to plant protection reasons (*Botrytis*). In case of spring plantation, most strawberry growers remove the flowers so that the plants use water and nutrients to strengthen the rootstock and do not concentrate on yield [11]. However, if we remove the flowers, we can expect a higher degree of tendril formation, the removal of which requires considerable workload [12]. Out of this consideration in our experiment we kept the crop of year 1.

Since these are intensive cultivars in conventional cultivation, the yield of the cultivars is between 800 – 1500 g/ plant (‘Joly’: 800 g/plant [9]; ‘Asia’: 1000 g/plant [13]). In contrast, under ecological conditions only half of that yield can be achieved. In our 2017 (year 2) experiments (Figure 7) the yield of the ‘Asia’ (360–425 g/plant) approached values reported in the experimental studies performed under ecological conditions (400 g/plant [14], and 3.5 kg/m^2 [15]). ‘Joly’ also showed lower yields that year (225–315 g/plant).

In 2016 we could obtain a statistically significant difference in the ‘Asia’ cultivar between the cut grass – straw and the cut grass – control treatments and in the case of

'Joly' between the black geotextile – straw and the straw – control treatments. In 2017 only in case of the 'Joly' did we find a significant difference between the straw – control treatments.

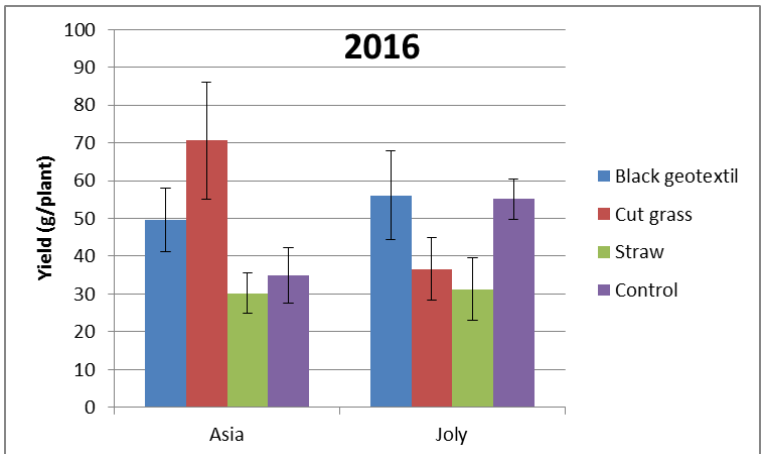

Figure 6. Average yield of strawberries (g/plant) and standard deviation of data under organic growing conditions (Kecskemét, 2016)

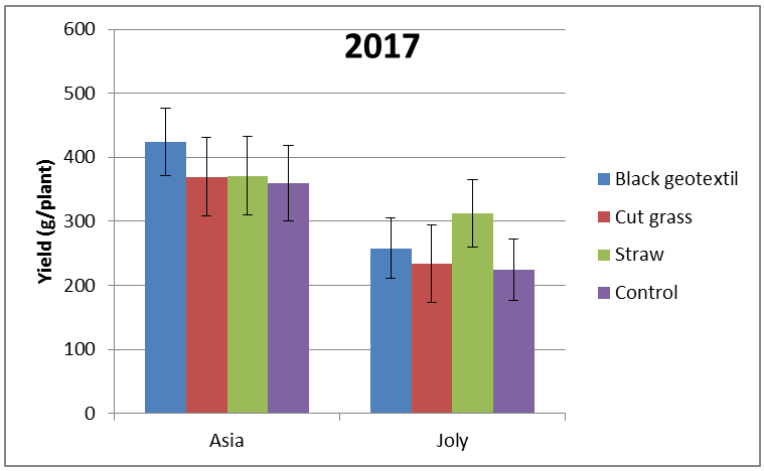

Figure 7. Average yield of strawberries (g/plant) and standard deviation of data under organic growing conditions (Kecskemét, 2017)

In the first year (2016) the amount of yield is below what can be expected in the year of plantation. The main reason for this is that at the beginning of ripening we could not provide adequate water supply which had a great effect on the size of the primary fruits. According to breeders both varieties are suitable for organic cultivation but this is primarily due to their disease resistance. It is our experience that both varieties require intensive water supply in case of low precipitation.

Due to unfavorable experimental conditions, the first year was considered a pre-trial, so only 10 – 10 plants were designated per treatment. In the second year (2017) we increased the number of plants in the study for a more reliable statistical evaluation. The yield was similar to the data available in the literature dealing with organic strawberry cultivation. The 'Joly' yield did not reach the expected quantity. We assume that higher yields on higher quality soil are achievable for this cultivar.

The impact of different soil mulching methods on fruit quality and yield is unclear on the basis of the data collected during these two years, so we will continue with the experiments.

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