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Profitability of different technologies of strawberry cultivation

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Abstract. The experiments with strawberries were carried out in 1999–2001. There were two cultivation types in the experiment: plastic mulch and straw mulch with burning after harvesting. The present research investigated the influence of mulches and cultivars on strawberry yield and profit. Straw mulch suits for 'Jonsok' and 'Bounty' because it increases yields. In places, where late-spring frost damages are usual, the growing of early cultivars with straw mulch would be practical. Plastic mulch suits better for cultivars susceptible to grey mould ('Senga Sengana'). It is useful to grow different cultivars because their yields are different according to years. The yield of the plant depends on the cultivar and on the cultivation technology. In year 2000 'Jonsok' grown with straw was more productive and profitable than other cultivars. In 2001 'Senga Sengana' grown with straw was the most productive and more profitable than 'Jonsok' and 'Bounty'. The burning of leaves flights pests and weeds and farmers can save on chemicals. Using straw mulch is more perspective for getting higher yields and profit.

Key words: mulch, burning, defoliation, profit, cultivar

INTRODUCTION

There are two main cultivation technologies of strawberries in Estonia: plastic and straw mulch. Plastic has the following advantages: there are less weeds in plantation, soil moisture is better preserved, fruits are cleaner and of higher quality. Plastic mulch is relatively expensive and plantation has to be fertilised before placing the plastic, because later it is more difficult to fertilise. Quality of the yield would drop already after the second harvest (Karp et al., 2002). One of the advantages of straw is its cheapness, and straw also reduces late-spring frost damages, whereas straw itself has to be weedless.

In 1999 experiments were started in cooperation with Kemira Estonia Ltd and the Ministry of Agriculture to establish the influence of burning on distribution of diseases and pests. The results of the experiments have shown that in Estonian conditions after the burning plants have a two-month growing season before strong frosts in October. By this time, new foliage, which can protect plants in winter, has grown. The influence of burning on the twospotted spider mite (*Tetranychus urticae*) has also been explored. The results showed that the twospotted spider mite disappeared after the burning. Withered seeds had also burned with straw and foliage. After the burning, new leaves grew within a week (Metspalu et al., 2001).

There is a tendency to reduce the use of chemicals in strawberry cultivation. It is important to find new ones, or use some old agrotechnical methods, which could inhibit distribution of diseases and pests. The aim of this research was to investigate the influence of mulches and the productivity of plants on the profitability of strawberry growing.

MATERIALS AND METHODS

The influence of defoliation was examined in an experiment started in 1999. The experiment was located in a commercial association Vasula Aed, Tartu County. The experiment was limited to 1.2 ha, and the size of the plot was 0.2 ha. The planting density was three plants per one meter. Spaces between the rows were 1.20 meter with plastic, and 0.9 meter with straw. Rows covered with plastic mulch were planted manually and rows without mulch (after straw mulch) were planted by a machine. In the harvest year, straw was spread in March, when earth was still frozen. Plants were also covered with straw. In April plants were divested from straw and straw remained till the end of harvesting. After harvesting, leaves were cut, and some days later, when leaves had become dry, straw and leaves were burnt. Spaces between the rows were cultivated after the defoliation.

There were 2 variants with 3 cultivars ('Jonsok', 'Senga Sengana', 'Bounty') in the trial: plastic mulch (control) and straw mulch, where defoliation took place after the harvesting. Commercial yields of both variants were weighed and calculated per hectare. In each variant, commercial yield per plant was also weighed (g/plant). In this case, data were gathered from 10 plants in three replications. Data were analysed by a two-way analysis of variance (Factors: A – cultivar, B – mulch), significance level at $P < 0.05$.

To evaluate the profitability, it is necessary to know costs. Costs and profit were calculated per hectare (EEK/ha). Pre-establishing costs were the same for both cultivation technologies:

- Chemicals and weed control – 1732 EEK.
- Fertilisers and fertilising – 2595 EEK
- Ploughing and cultivating – 1527 EEK

Establishing costs differed because different numbers of plants were planted per hectare. There were 33,000 plants with straw and 25,000 plants with plastic. The price of one plant was 1.5 EEK. Costs of plants and planting amounted accordingly 56,100 and 42,500 EEK. Straw mulch with laying cost 4,072 EEK. Plastic and its laying is more expensive – 12,058 EEK per hectare. Prices of fertilisers and chemicals are from Kemira Estonia Ltd. Machines for accomplishing fieldwork cost 235 EEK/h, including labour. Värnik's (2001) data were used to calculate maintenance costs. 309 hours and 3,106 EEK per hectare were spent to maintain the plantation with plastic. In the straw mulch plantation there was more maintenance work and costs were 5,962 EEK/ha. Establishing costs were divided equally between four harvesting years.

In the case of plastic mulch, plants were sprayed with fungicides and insecticides to prevent pests and diseases. Maintenance work required 7,988 EEK/ha in total. There was no chemical weed control in the case of straw mulch, as burning prevented pests and diseases. Because of that there were no costs of chemicals. For maintaining (cutting space between the rows, weeding) 514 hours and 5,174 EEK per hectare have

been spent. For the harvesting of one hectare 800 man-hours were needed. Strawberry pickers were paid according their work. The average of 2.50 EEK/kg was paid to pickers. 10 EEK/kg has been used for calculating strawberry sales price.

RESULTS AND DISCUSSION

The results of the year 2000 were as follows: the yield of 'Jonsok' was 16,335 kg/ha in straw mulch, and 5 300 kg/ha in plastic (Fig. 1). With plastic mulch, costs equaled 40,998 EEK/ha and income 53 000 EEK/ha. With straw, the numbers were 67,889 and 163,350 EEK/ha, respectively (Fig. 2). Difference between the yields was 11,035 kg and in profit 83,459 EEK per hectare (Fig. 4).

The yield of 'Senga Sengana' was 7,194 kg/ha with straw, and 6,775 kg/ha with plastic. Costs were 45,036 EEK/ha with straw and 44,685 EEK/ha with plastic, and income 71,940 and 67,750 EEK/ha, respectively (Fig. 2). 'Senga Sengana' had the smallest difference between the yields (419 kg/ha, strawberries grown with straw more than with plastic) and because of that the difference between the profits was small too.

The yield of 'Bounty' was 12,012 kg/ha with straw, and 5,450 kg/ha with plastic. The yield of strawberries grown with straw was higher by 6,562 kg/ha and profit was also bigger. Costs were 57,081 EEK/ha with straw, and 41,373 EEK/ha with plastic. Income amounted 63,039 and 54,500 EEK/ha and profits 63,039 and 13,127 EEK/ha, respectively.

In 2000 fruits of 'Jonsok' grown with plastic mulch ripened 3 days earlier (Fig. 5). Picking with straw was 8 days longer than with plastic. The number of picking days was 8 with plastic, and 10 with straw.

The picking of 'Senga Sengana' lasted from 25 June to 22 July. The picking of strawberries grown with plastic mulch started 6 days earlier and ended 3 days earlier than with straw.

'Bounty' yielded from 25 June to 25 July. The picking of strawberries grown with straw mulch began two days later and lasted nine days longer. Fruits were bigger in almost all picking days than with plastic mulch. The number of picking days was smaller with plastic (8) than with straw (11).

In 2000 'Jonsok' grown with straw gave the highest yield, but in 2001 'Senga Sengana' grown with straw (Fig. 1, 3) gave the highest yield (17,721 kg/ha) (costs were 71,354 and income 177,219 EEK) and profit (105,856 EEK/ha). The yield of 'Bounty' grown with straw mulch was for 1,724 kg, and the profit was by 13,627 EEK bigger than with plastic mulch. The yield of 'Jonsok' grown with straw was 10,626 kg/ha and 7,850 kg/ha grown with plastic mulch. Costs were 53,016 EEK/ha and income 106,260 EEK/ha with straw, with plastic the numbers were 47,373 and 78,500 EEK/ha (Fig. 3). The numbers of profit were 52,644 and 31,127 EEK/ha, respectively (Fig. 4).

In 2001 harvesting period started few days later in the plantation with straw mulch but ended at the same time as with plastic mulch. The harvesting time may be expanded to 5–6 weeks using various mulches and growing technologies. In production plantations it is recommended to grow cultivars of different ripening time on different mulches. This enables to prolong the harvesting time thereby decreasing the strain of work at harvesting and marketing.

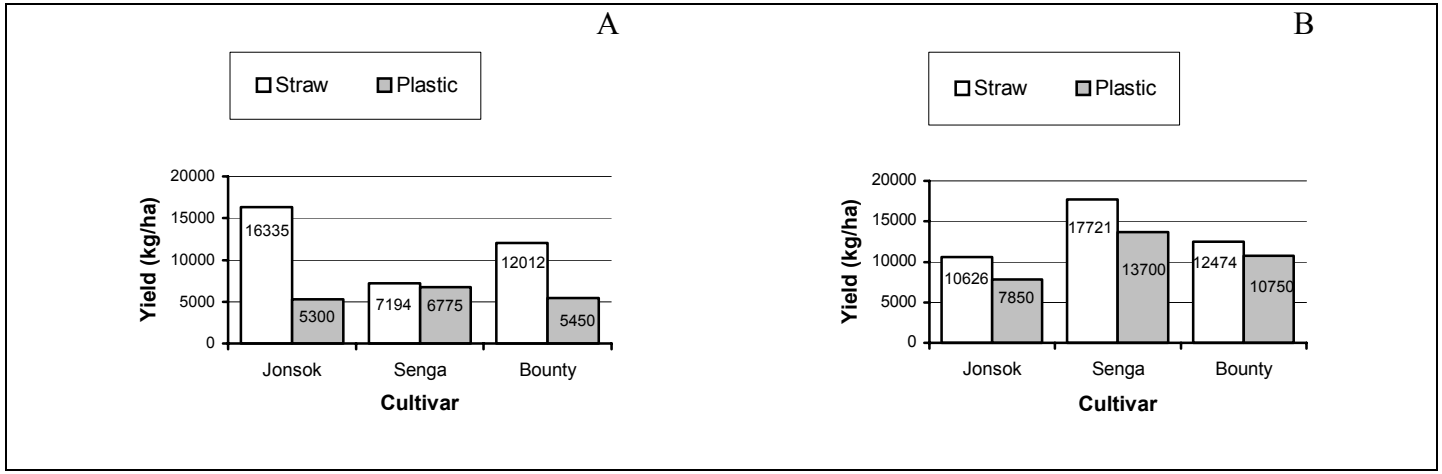


Fig. 1. Yield (kg/ha) years 2000 and 2001. A – Yield in 2000, B – Yield in 2001.

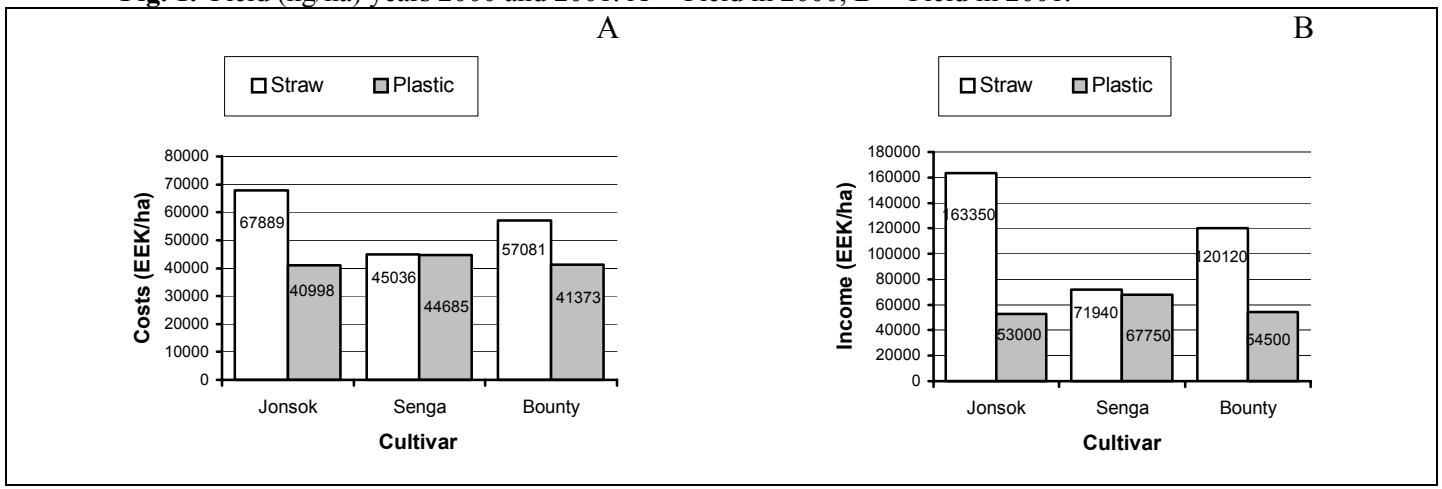


Fig. 2. Costs and income (EEK/ha) in 2000. A – Costs, B – Income.

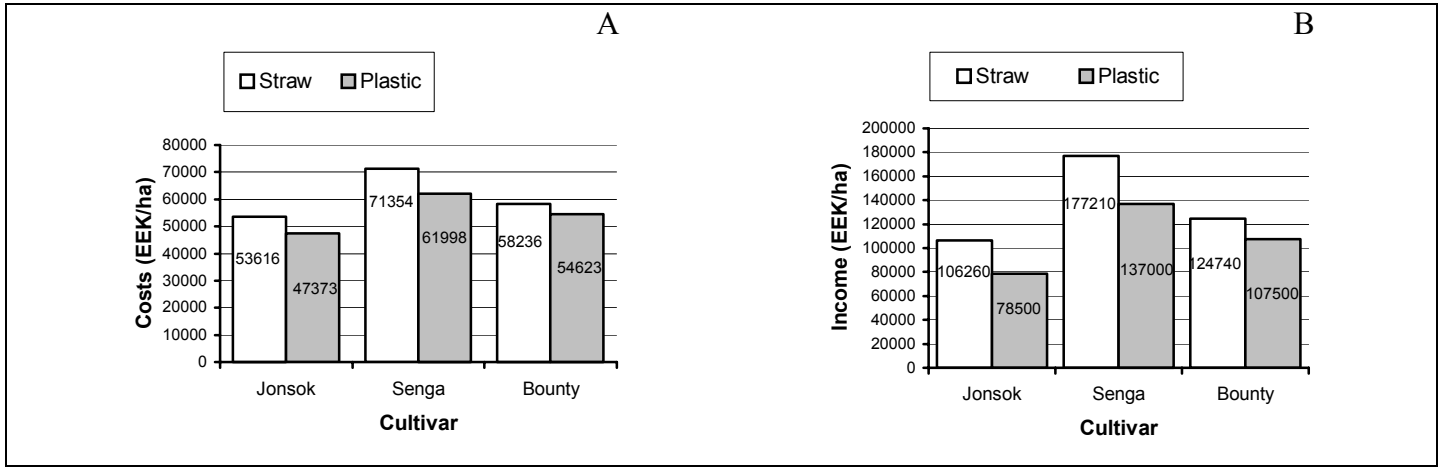


Fig. 3. Costs and income (EEK/ha) in 2001. A – Costs, B – Income.

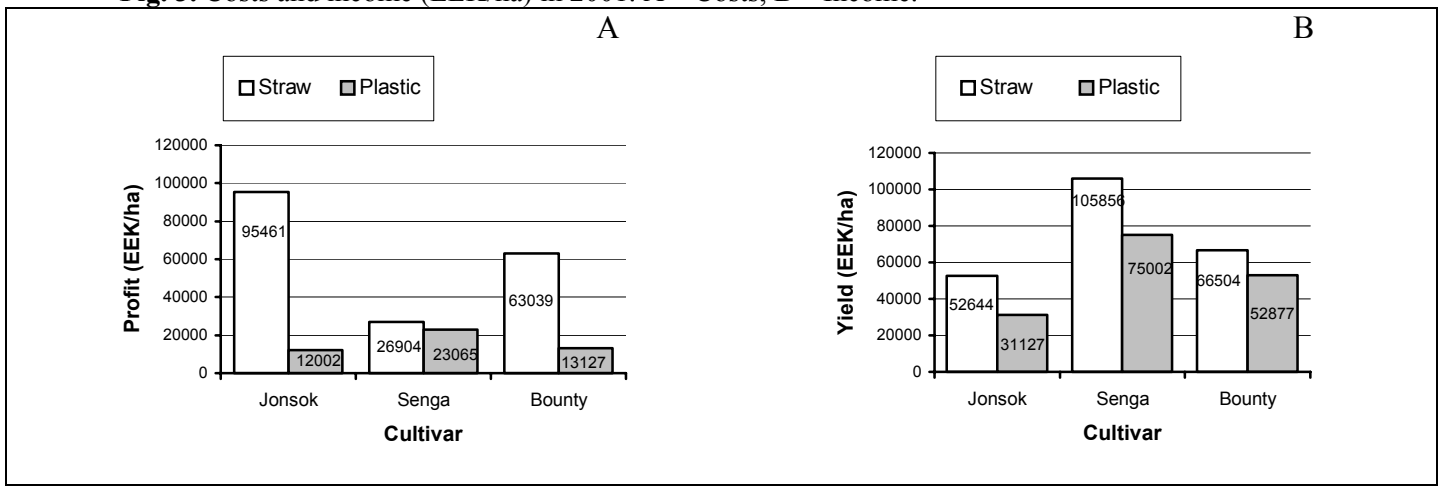


Fig. 4. Profit (EEK/ha) in 2000 and 2001. A – Profit in 2000, B – Profit in 2001.

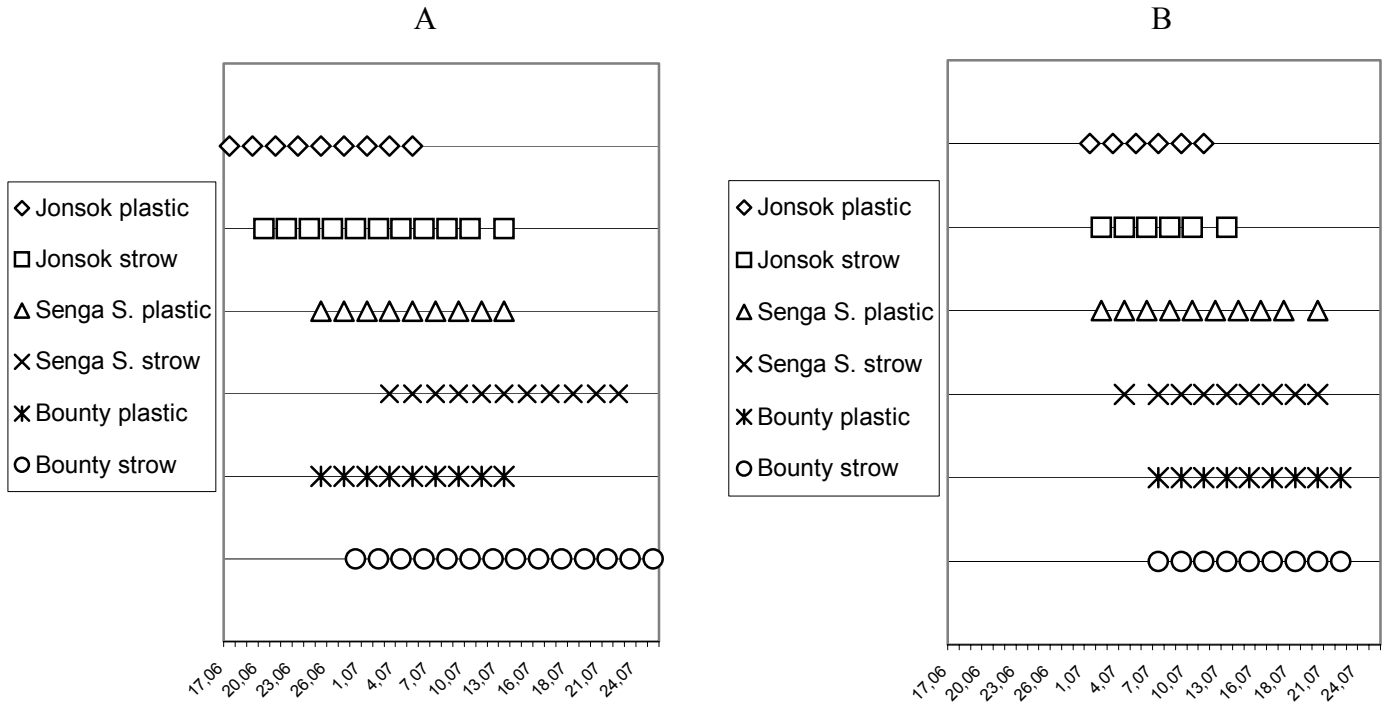
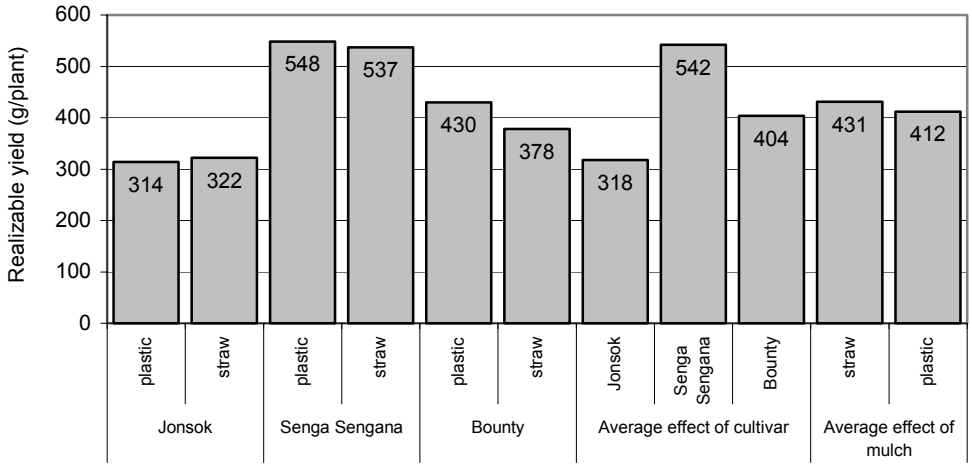


Fig. 5. Picking days in 2000 and 2001. A – Picking days in 2000, B – Picking days in 2001.

A



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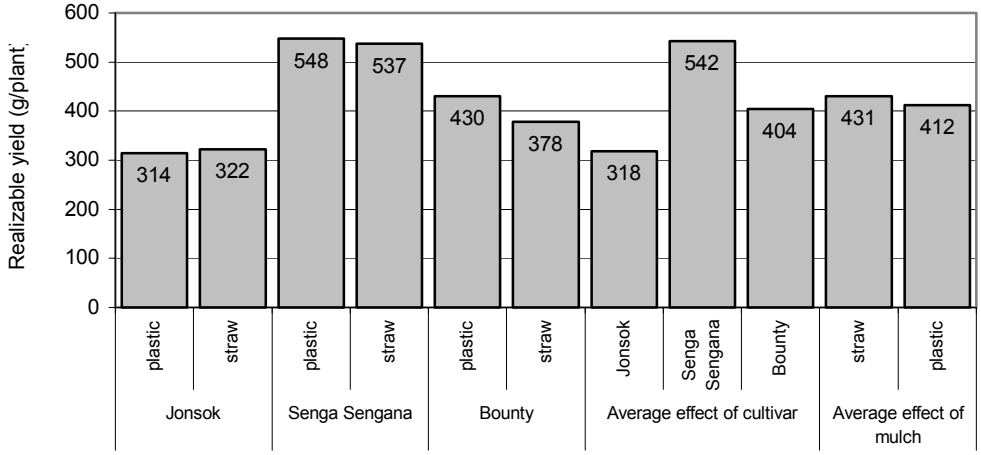

Fig. 6. Realizable yield of the plant (g/plant) in 2000 and 2001. A – Yield in 2000, $LSD_{95\%variant}$= 68, $LSD_{95\%cultivar}$= 48, $LSD_{95\%mulch}$= 39. B – Yield in 2001, $LSD_{95\%variant}$= 146, $LSD_{95\%cultivar}$= 103, $LSD_{95\%mulch}$= 84.

Profitability calculations have been made earlier and have given the following results: in 1996 with straw mulch profit was 64,000 EEK/ha and with plastic mulch 59,000 EEK/ha. Yields were 8 t/ha (straw) and 7 t/ha (plastic) (Eskla, 1996). Differences are due to the higher yields in the current experiments and not using chemicals with straw.

The results were influenced by several factors. The amount of plants was different while using different mulches. Plantation established with plastic mulch had less plants

than the plantation with straw mulch (33,000 plants with straw and 25,000 plants with plastic). Productivity also depends on the yield of every single plant. Because of that it is necessary to explain how cultivation technology influences the productivity of a single plant. As the data show, the selection of mulch had the biggest influence on the 'Jonsok' (Fig. 6). The average yield per plant was 212 g with plastic and 495 g with straw mulch. It was caused by the weather of the year 2000, which was not favourable for strawberries. Weather was warm at the end of April, and plants started to grow. But a dry cold period followed, and flower buds that bloomed earlier were damaged by night frosts (Karp, 2001). In straw mulch, the blossoms had not opened. The researching of frosts has shown that damages of 2 blooms reduce the productivity by 36–43% (Khanizadeh, et. al, 1992). Plants grown with straw flowered later (in comparison with plastic mulch) and this was the reason why frost damages did not occur. Therefore 'Jonsok' had a low yield with plastic and a marketable higher yield with straw mulch. As the average of the experiment, the most productive was cultivar 'Jonsok' with straw mulch.

In 2001 cultivar peculiarities (time of blossoming) influenced the yield. As the average of the experiment, the most productive was 'Senga Sengana'. The blossoms of 'Bounty' were tender and were damaged by the late-spring frosts, which had influenced results. Only few blossoms of 'Senga Sengana' had been damaged. In experimental plantation there were almost no frost damages on cultivar Jonsok and influence of mulch did not appear in this year.

Influence of factors mentioned above varies annually. In year 2000 straw had a significant influence to 'Bounty'. In 2001 cultivar peculiarities influenced the harvesting period. `Senga Sengana' had the longest harvesting period (Fig. 5).

Different mulches are suitable for different cultivars. For cultivars which are sensitive to grey mould, like 'Senga Sengana', plastic mulch is better as it guarantees smaller distribution of grey mould. Straw mulch is more suitable for 'Jonsok' and 'Bounty'. Cultivar comparisons in experiments have shown that cultivars 'Bounty' and 'Senga Sengana' have prospect in large-scale production. Profit for these cultivars was 5–6 EEK per plant, and productivity was also stable. In large-scale production, the profit of 'Bounty' and 'Senga Sengana' could be 130,000–160,000 EEK per hectare (Karp, et al., 1999). 'Senga Dulcita' and 'Lina' are also profitable cultivars in Estonia. Yields were 489 and 447 g per plant (three years average) and marketable yield was 440 g and 452 g per plant (Karp et al., 2000).

Cultivars 'Bounty' and 'Senga Sengana' had higher profitability in experiments carried out in 1997–1999. During the three years, the average production was 504 g and 447 g per plant. The productivity was unstable: 1998 was rainy, 1999 was hot and dry. The yield of 'Jonsok' was lower for a half (268 g per plant) than in cultivars mentioned above (Karp et al., 2000). But it is compensated by the early yield of 'Jonsok', which gives advantage in price when the offering at the market is lower andthe prices are higher. But it has to be considered that the price drops quickly when the number of sellers increases. That is the reason why a producer cannot plan selling a large amount at a very high price at the beginning of the season. At the end of the season, when production is decreasing, there is demand at the market making prices rise again.

CONCLUSIONS

- Straw mulch suits for ‘Jonsok’ and ‘Bounty’ because it makes yields higher. In places where late-spring frost damages are usual, the growing of early cultivars with straw mulch would be practical.
- Plastic mulch suits better for cultivars susceptible to grey mould (‘Senga Sengana’).
- It is useful to grow different cultivars because they will yield differently according to years.
- The yield of a plant depends on the cultivar and on cultivation technology. In the year 2000 ‘Jonsok’ grown with straw was more productive and profitable than other cultivars. In 2001 ‘Senga Sengana’ grown with straw was the most productive and more profitable than ‘Jonsok’ and ‘Bounty’.
- Burning of leaves flights pests and weeds and a farmer can save on chemicals.
- Using straw mulch has more prospect for getting higher yields and profit.

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