EVALUATION OF STRAWBERRY CULTIVARS IN ESTONIA

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14 strawberry cultivars ('Anne-Lise', 'Darunok', 'Gerida', 'Jewel', 'Melody', 'Pandora', 'Pegasus', 'Rhapsody', 'Symphony', 'Syrius', 'Vantage', and 'Wega'), together with 'Senga Sengana' and 'Venta' as standards, were evaluated in the experimental field of Polli Horticultural Research Centre of the Institute of Agricultural and Environmental Sciences of Estonian University of Life Sciences in 2005–2006. Winterhardiness, phenology, damage of blossoms by spring frosts and blossom weevil (*Anthonomus rubi*), yield, quality of fruits and hardiness of fruits to grey mould (*Botrytis cinerea*) and other fruit rots were investigated. The cultivars 'Jewel', 'Syriusz' and 'Wega' appeared to be prospective for cultivating in Estonia. These three cultivars had good yield and firm fruits. 'Pandora' is of interest for being a late ripening cultivar with large fruits with relatively high vitamin C content (40 mg/kg fresh fruits) but in case of rainy weather the quality of fruit is declining. This cultivar cannot be grown as monoculture as it has only female flowers. Being a late flowering plant 'Pandora' escapes the spring frost damage.

Key words: *Anthonomus rubi*, blossoms, strawberry yield, weight of fruit.

Introduction. According to the data of Estonian statistics, strawberry plantations comprised 865 hectares in Estonia in 2005. The yield per hectare is varying from year to year, but on the average it is around 3 tons per hectare. Strawberry yield greatly depends on the weather conditions during the dormancy and growth periods (Nes, 1997, Battery et al., 1998; Hieteranta, Matala, 2002; Shokaeva, 2006) resulting in large yield differences between years. Instability in the yield over the years can be seen in the current trial as well. Accordingly, there is a need for cultivars that would not respond so strongly to extreme weather conditions and would give a good and high quality yield meeting the needs of both the grower and the consumer. Severe damage to yield is caused by spring frosts, occurring during bloom, and strawberry weevil, the damage of these being dependent on the weather conditions and resistance of the cultivars. In Estonia strawberries are mostly produced for fresh market and therefore fruit size, its attractiveness and shelf life are particularly important. Increased focus on nutritional health aspects of berries stresses the importance of the nutrient content of fruits. In order to improve the range of cultivars in use, the cultivars that have been prospective in other regions are introduced and tested in local climatic conditions. 'Senga Sengana' is used as a standard, since it has been in the list of recommended cultivars for a long period. 'Senga Senga' is a cultivar with good winterhardiness and stable yields, and in spite of having some deficiencies the

consumer interest in it has not faded. 'Venta' was included in the trial as a second standard. 'Venta' is being valued for its tasty and attractive fruit and very good winterhardiness and it is a popular cultivar for home gardens.

Material and methods. The experiment was established at Polli in the spring of 2004 with fourteen cultivars: 'Anne-Lise', 'Darunok', 'Gerida', 'Jewel', 'Melody', 'Pandora', 'Pegasus', 'Rhapsody', 'Symphony', 'Syrius', 'Vantage', and 'Wega', together with 'Senga Sengana' and 'Venta' as standards. The plot was planted with four replicates of 20 plants per cultivar with plant spacing of 1.20×0.30 m. Black plastic mulch was used only in the second experiment. During two subsequent years, 2005 and 2006, common phenological examinations, determination of winter damage, floral injury due to spring frost, yield, berry mass, taste and attractiveness evaluations were made. Damage due to diseases and pests, grey mould (with other fruit rots), and blossom weevil was evaluated. Dispersion analysis was used for statistical treating of data.

Results. Development of the yield over the years. In both years overwintering of cultivars was good as there was enough snow that could protect the bushes from low temperature damage (Table).

Table. Some biological and economically important characteristics of the strawberry cultivars. Average of the two trial years 2005–2006 m.

Lentelė. Kai kurios svarbios biologinės ir ekonominės braškių veislių charakteristikos. Dvejų metų (2005–2006) vidurkiai

Cultivar Veislė	Inflorescences per plant Žiedynai ant augalo	Flowers per plant Žiedai ant augalo	Spring frost damage in 2006 Pavasarių šalnų žala 2006m. (%)	Damaged fruit Pažeistų uogų (%)	Winter hardiness (score 1–9) Atsparumas žiemos šalčiams, balais (1–9)
'Senga Sengana'	9.8	79	0.6	6.2	9
'Anne-Lise'	11.2	98	15.8	5.5	9
'Darunok'	9.8	66	12.5	1.8	9
'Gerida'	4.2	31	27.4	7.4	9
'Jewel'	9.8	81	10.4	3.6	7
'Melody'	7.5	58	5.7	3.4	9
'Pandora'	8.9	61	0	8.8	9
'Pegasus'	6.2	50	3.5	2.0	9
'Rhapsody'	7.5	54	2.3	5.0	7
'Symphony'	9.0	70	3.5	5.6	9
'Syriusz'	8.4	72	1.9	2.8	9
'Vantage'	6.9	56	10.3	2.0	7
'Venta'	8.5	64	7.8	3.8	9
'Wega'	12.6	102	22.1	4.0	9
LSD 95%	2.1		14.8		
R 95%					

In 2005 the strawberries started to flower earlier than in 2006, but the beginning of fruit ripening was rather simultaneous in both years. The basis for a good yield is laid already during flowering. Within the range of tested cultivars the number of inflorescences and number of flowers was higher in 2006 than in 2005, only 'Anne-

Lise' and 'Wega' had more flowers per plant in 2005. 'Wega' had also the highest average numbers of flowers and inflorescences per plant over two years (Table). The overall average yield was three times lower in 2006 than in 2005. Average of number of flowers per inflorescence (including data of two years) varied between 7.0–8.9 and there was no significant difference between cultivars. In 2005 majority of cultivars had more flowers per inflorescence than in 2006

In 2005 there no spring frost damage was observed in blossoms and damage from blossom weevil was not remarkable either, being the highest with 'Venta' (4.8%). In 2006, however, there was spring frost damage in blossoms and the damage was most severe in cultivars 'Gerida' and 'Wega'. The same pattern could be observed with blossom weevil damage: in 2006 it was remarkably higher than in 2005; overall average was more than four times higher – 2.0 and 9.5%, respectively (Fig. 1). On the average cultivars 'Anne-Lise', 'Darunok', 'Gerida', 'Melody', 'Rhapsody', 'Syriusz' and 'Venta' were more affected than standard cv. 'Senga Sengana'. The most severe damage was observed in cv. 'Venta' (12.3%). 'Senga Sengana' and 'Wega' were relatively fairly affected in both years.

Fig. 1. Strawberry blossom weevil damage in 2005 and 2006.

Effect of the year and cultivar.

* indicates significant ($p < 0.05$) differences from the standard 'Senga Sengana'.

1 p a v. Avietinių žiedgraužių pažeisti braškių lapai 2005 ir 2006 m.
Metų ir veislės įtaka.

* patikimi ($p < 0,05$) skirtumai nuo standarto 'Senga Sengana'.

In 2005 all cultivars gave rather good yields. The yield of three cultivars 'Wega', 'Jewel' and 'Venta' exceeded this one of the standard cv. 'Senga Sengana' (Fig. 2). Very modest yields were collected from 'Gerida' and 'Rhapsody' due to severe damage from strawberry mite (*Phytonemus pallidus* ssp. *fragariae* Zimm.) (damage rates 9 and 7, respectively).

Although the number of flowers was high in 2006 the yield remained at extraordinary low level. To some extent the plants were less vigorous due to the strawberry mite damage the year before followed by the unfavourable growth period of drought and hot weather. The average yield of the cultivars was almost three times lower than in 2005. In this year the best yielding one was 'Syriusz'. On the average over the years the best yielding cultivars were 'Wega', 'Venta' and 'Syriusz'.

Fig. 2. Influence of cultivar and year on strawberry yield (g per plant)
2 p a v. Veislės ir metų įtaka braškių derliui, g nuo augalo

In 2005 average berry weight was twice as high as in 2006. In both years of the experiment the largest fruits produced cultivars 'Pandora', 'Syriusz' and 'Venta'. Cultivars 'Pandora', 'Pegasus', 'Rhapsody', 'Symphony', 'Syriusz' and 'Wega' on the average developed larger fruits than the standard cv. 'Senga Senga'. The percentage of damaged fruit was higher in 2005, but still remained on a rather low level. More damaged fruits produced cultivars 'Pandora' and 'Gerida' – 13.6 and 12.9%, respectively. The cause of high percentage of inferior quality fruit of 'Pandora' was fruit cracking after heavy rainfall; the fruits of 'Gerida' were spoilt as a result of strawberry mite damage.

Fig. 3. Influence of cultivar on the weight of fruit
3 p a v. Veislės įtaka uogos masei

Discussion. The number of flowers and inflorescences was higher in 2006 than 2005 – in the second year of growth the plant had more crowns than in the first year. On the other hand, in August 2004, that is the period of flower bud initiation, it was cooler and dryer in than in the similar period in 2005, thus conditions were more favourable for termination of growth and floral bud differentiation (Kinnanen, Säko,

1979). It is known that there is a strong positive correlation between the number of flowers and the yield (Kikas, Libek, 2005). The current trial did not reveal this correlation as there were other factors that had significant impact on the yield levels.

The years during the trial were very different in respect of weather conditions, revealing the negative impact of unfavourable climate on fruit weight and formation of the yield. At the same time the cultivars responded diversely to the unfavourable weather conditions. In spite of disadvantageous weather, cv. 'Syriusz' gave a considerable yield in 2006. However, 'Wega', which had given very good yield in 2005, had a very low yield in 2006. Based on the data from the first year, cv. 'Jewel' was considered to be one of the best in the range of cultivars tested, as it had shown a good yield with tasty fruits that were firm and easy to handle, but in 2006 its yield remained moderate. In 2006 the yield level was substantially reduced also by the spring frost damage. The endurance of blossoms at freezing temperatures differs with cultivars. 'Gerida' and 'Wega' had blossoms that were most sensitive to frost. In the same year rather severe damage from blossom weevil also occurred. Blossom weevil is known to be a cultivars specific pest (Simpson et. al., 1997; Kikas, Libek, 2005; Libek and Kikas, 2002). It has been noted earlier that blossom weevil likes cv. 'Venta' (Kikas, Libek, 2002). Similar effect was observed in the present study where 'Venta' was most severely affected and 'Senga Sengana' was not remarkably affected by blossom weevil. Rather severe damage from blossom weevil occurred also with cultivars 'Darunok' and 'Gerida'; cv. 'Jewel' and 'Vantage' got relatively fair damage. On the average over the two years 'Wega', 'Venta' and 'Syriusz' gave better yields than the standard 'Senga Sengana'. Two of the above mentioned cultivars had given good yields also in the similar trial in Lithuania (Uselis, Rašinskienė, 2000). 'Jewel' also had rather high yield. Similar to our observations on blossom weevil damage on 'Pegasus' and 'Wega' that remained at the same level with 'Senga Segana' was reported in the Polish trial (Labanowska, 2004). Fruit weight is a cultivars specific feature that can be affected by the growth conditions. The average fruit weight is mostly influenced by the damage caused either by spring frost or blossom weevil. When first emerging flowers are affected, it influences significantly the average fruit weight and yield in general as the subsequently emerging fruit never grows into the size the first fruits would have reached. (Faby et al., 2004). When the last blossoms are affected the damaged is not remarkable. In this trial 'Pandora', 'Syriusz' and 'Venta' produced the largest fruits.

On the base of these preliminary results from the range of cultivars that were included in the trial, for the first time two would be suitable for growing in Estonian climatic conditions. The two are 'Syriusz', a cultivar that had stable and high yields, and 'Jewel' – also high yielding cultivar with attractive firm fruit, although it responded more easily to unfavourable weather conditions. 'Jewel' was also less affected by the blossom weevil. 'Wega' was a good yielding cultivar but reacted strongly to unfavourable environmental conditions. Its fruits were not firm and attractive. 'Pandora' is a very late cultivar bearing large beautiful fruit. In order to give final estimates about the suitability of these cultivars for growing in Estonia a longer testing period is needed.

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BRAŠKIŲ VEISLIŲ ĮVERTINIMAS ESTIJOJE

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Santrauka

14 braškių veislių ('Anne-Lise', 'Darunok', 'Gerida', 'Jewel', 'Melody', 'Pandora', 'Pegasus', 'Rhapsody', 'Symphony', 'Syrius', 'Vantage', ir 'Wega') kartu su standartinėmis 'Senga Sengana' ir 'Venta' 2005–2006 metais buvo įvertintos Estijos gyvenimo mokslo universiteto Žemės ūkio ir aplinkos mokslų instituto Polli žemės ūkio tyrimų centro eksperimentiniame lauke. Tirtas atsparumas žiemos šalčiams, fenologija, pavasarinių šalnų ir avietinių žiedgraužių (*Anthonomus rubi*) žala žiedams, derlius, uogų kokybė bei jų atsparumas kekeriniam (*Botrytis cinerea*) ir kitiems vaisių puviniams. Veislės 'Jewel', 'Syriusz' ir 'Wega' pasirodė esančios perspektyvios auginti Estijoje. Šios trys veislės davė gerą derlių, ir jų uogos buvo tvirtos. 'Pandora' sudomino kaip vėlai prinokstanti veislė, vedanti dideles uogas, kuriose palyginti daug vitamino C (40 mg/kg šviežių uogų), tačiau lietingu oru šios veislės uogų kokybė suprastėja. Ši veislė negali būti auginama kaip monokultūra, nes turi tik moteriškus žiedus. Kadangi 'Pandora' žydi vėlai, ji išvengia pavasarinių šalnų.

Reikšminiai žodžiai: *Anthonomus rubi*, braškių derlius, uogų masė, žiedai.