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SWEET CHERRY FRUIT CHARACTERISTIC IN COVERED ORCHARDS

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The aim of evaluations performed in experimental plantings of the Research and Breeding Institute of Pomology Holovousy Ltd. was to verify the effect of covering systems on fruit characteristics – size, weight, firmness and soluble solids content (SSC). The research was focused on evaluation of fruit characteristics in 2017 and 2018 on fourteen cultivars: ´Amid´, ´Cristiana´, ´Early Korvik´, ´Elza´, ´Fabiola´, ´Felicita´, Horka´, ´Justyna´, ´Kasandra´, ´Kordia´, ´Korvik´, ´Tamara´, ´Těchlovan´ and ´Vanda´. The tested cultivars were grown in an IPM irrigated covered orchard. The largest fruit size was recorded for the cultivar ´Tamara' with 29.5 mm followed by the cultivar ´Horka' with 29 mm and ´Felicita´ with 28.6 mm. The greatest weight was recorded for the cultivar ´Tamara' with 12.4 g followed by ´Felicita´ with 12.3 g. The greatest firmness was recorded in fruits of the cultivar ´Amid´ with index 77.5 and ´Tamara´ with index 73.2. High correlation between fruit characteristics was found only between weight and size of fruits (correlation coefficient 0.88). High differences were recorded between years. In 2017, fruits characteristics were higher (size 27.5 mm, weight 10.9 g, firmness 65.3, SSC 19.3 °Brix) while in 2018, fruit characteristics were lower (size 26.5 mm, weight 9.2 g, firmness 59.2, SSC 16.5 °Brix).

Keywords: *Prunus avium* L.; fruit quality; fruit weight; fruit size; fruit firmness; soluble solid content

Modern sweet cherry orchards are equipped with covering systems against rain which affect the quality of the fruit in particular by reducing the rain-induced fruit cracking. The positive effect of covered plantings is also higher fruit size and weight which increases the price of cherries and marketability of production. Nowadays, retail chains and consumers demand high-sized cherries over 30 mm in the width of the fruits (Measham et al., 2014, Meland et al., 2014). This size can be achieved by using covering systems against rain. Information related to the specific conditions of growing cherries in covered plantings, supplemented with knowledge about technologies of protection against major diseases and pests is essential for cherry growers. Higher quality and better marketability production from covered plantings is proved by ever-increasing areas of these systems in Europe and in all other continents. The most commonly used systems in practice include Haygrove tunnels (www.haygrove.com), and single-row systems e.g. VOEN system (www.voen.de). Other systems, such as retractable roof technology (www.cravo.com), are also used in North and South America. Regardless of the type of covering systems, the main objective is to achieve the harvest of high market quality fruits. The influence of the VOEN system on the quality of cherries was evaluated at the location Holovousy in the Research and Breeding Institute of Pomology, Czech Republic. The results are presented in this paper.

Material and method

The research was focused on covered experimental cherry plantings at the location Holovousy. Climatic conditions of Holovousy are characterized by average annual temperature of 8.1°C and average annual rainfall of 655 mm. The soil was medium loam sandy with rather deep cultivated layer on gravel substrate. The orchard was located at the altitude of 300–370 masl. Experimental trees were trained as spindles using strong wooden stakes as supports. Clean strips were kept under the trees by contact herbicides whereas frequently cut sod was kept in alleys between the tree rows. Fertilizers were applied according to soil analyses. Spraying treatment against pests and diseases was conducted based on recommendations used for commercial orchards. The tested cultivars were grown in an IPM covered orchard. Irrigation was applied in the covered orchard. The experiments were focused on sweet cherry fruit characteristics.

The aim of the experiments performed in 2017–2018 was to verify the effect of covering systems (company VOEN, Germany) on cultivar differences in fruit weight, fruit size, fruit sweetness (soluble solids content; SSC) and fruit firmness. In this evaluation there were involved cultivars ´Amid', ´Early Korvik', ´Elza', ´Fabiola', ´Felicita', ´Horka', ´Christiana', ´Justyna', ´Kasandra', ´Kordia', ´Korvik', ´Tamara', ´Těchlovan' and ´Vanda'.

The fruits were harvested at the ripening time according to the individual cultivars. The samples were transferred to the laboratory and evaluated immediately. In each sample, 25 fruits were evaluated for each genotype in two replicates. Fruit weight in grams, fruit size (width in diameter) in millimetres, fruit soluble solids content (SSC) in Brix and fruit firmness were recorded. SSC was measured using a digital refractometer HI 96801 (HANNA Instruments, USA), fruit firmness by a Durofel instrument (Copa-Technology, France)

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by index of 1–100 (with 100 being the maximum firmness), weight on a digital scale Kern 440-49N (KERN & SOHN GmbH, Germany), and fruit width by digital callipers. All data were statistically processed by an analysis of variance by STATISTICA software (version 12, Stat Soft). Significant differences between the means for each sweet cherry cultivars were determined by the Tukey's test at p <0.05. The mutual dependence of two measured characteristics of individual fruits in all evaluated cultivars is expressed by correlation coefficients.

Table1 **Evaluation** of sweet cherry cultivars in 2017 and 2018

Cultivar	Weight (g)	Size (mm)	SSC (°Brix)	Firmness (index 1–100)
Amid	8.0 g	24.8 hi	19.1 ab	77.5 a
Cristiana	9.7 def	27.7 bcd	20.2 a	61.7 bcd
Early Korvik	10.0 def	27.0 de	17.4 bcd	58.7 cd
Elza	10.3 cde	27.3 cd	18.7 abc	66.3 b
Fabiola	10.5 cde	26.9 de	17.4 bcd	57.2 d
Felicita	12.3 ab	28.6 ab	15.1 e	64.6 bc
Horka	10.0 ab	29.0 ab	18.0 abcd	63.6 bc
Justyna	9.9 def	26.8 def	18.4 abc	59.0 cd
Kasandra	7.8 g	24.4 i	16.3 de	42.7 e
Kordia	10.6 cd	26.4 defg	19.0 ab	57.5 a
Korvik	9.5 ef	26.0 efg	17.1 cde	62.2 bcd
Tamara	12.4 a	29.5 a	18.3 abc	73.2 a
Těchlovan	11.1 bc	28.2 bc	17.2 cde	64.5 b
Vanda	9.1 f	25.8 gh	19.7 a	63.1 bc

Table 2 Correlation coefficients of fruit characteristics

Fruit characteristic	Weight	Size	SSC	Firmness
Weight	x	0.88	0.53	0.35
Size	0.88	x	0.33	0.38
SSC	0.53	0.33	x	0.33
Firmness	0.35	0.38	0.33	x

Table 3 Differences between years

Year	Weight (g)	Size (mm)	SSC (°Brix)	Firmness (index 1–100)
2017	10.9 a	27.5 a	19.3 a	65.3 a
2018	9.2 b	26.5 b	16.5 b	59.2 b

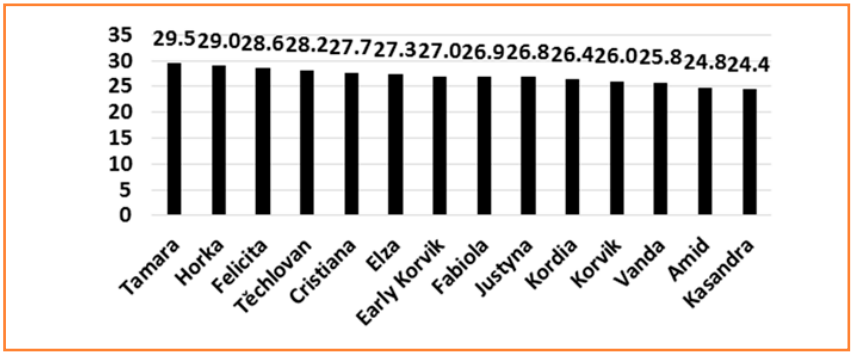

Figure 1 Evaluation of fruit size (mm)

Results and discussion

The results of the evaluation are shown in tables 1–3 and Figs 1–4.

Fruit size

Fruit size was higher in 2017 with the mean value of 27.5 mm than in 2018 with the mean value of 26.6 mm. The biggest fruits were recorded for the cultivar ´Tamara' (29.7 mm) followed by the cultivars ´Horka´ and ´Felicita´ with 29.0 mm and 28.6 mm, respectively.

Fruit weight

Fruit weight was higher in 2017 (10.9 g) than in 2018 (9.2 g). Year on year differences in the weight of the fruit were observed mainly in the cultivars ´Amid', ´Korvik' and ´Vanda'. The weight of the cultivar ´Amid' was by 25.1% lower in 2018 (6.8 g) than in 2017 (9.1 g). The same phenomenon was observed for ´Korvik' with the weight by 24.8% lower in 2018 (8.2 g) than in 2017 (10.9 g). The weight of the cultivar ´Vanda' was also lower by 25.2% in 2018 (7.8 g) than in 2017 (10.4 g). The greatest weight was recorded for the cultivar ´Horka' in 2017 (12.9 g). In both years, the cultivar ´Tamara' had the biggest fruit weight (12.4 g). In 2017, the smallest fruit weight was recorded by the cultivar ´Kasandra' (7.8 g).

Fruit firmness

Fruits were less firm (59.2) in 2018 than in 2017 (65.3). The greatest firmness was recorded for ´Tamara' in 2017 (82.7). In 2018, the highest fruit firmness was found for ´Amid' (74.5). On the contrary, the lowest firmness of 41.2 was recorded for the cultivar ´Kasandra' in 2018 and 44.2 in 2017.

SSC

Higher fruit sweetness was recorded in 2017 (19.3 °Brix) than in 2018 (16.5 Brix). This observation can be explained by hot weather during ripening in 2018. Fruits ripened very quickly and it had the impact on lower fruit sweetness and also fruit size (both weight and width).

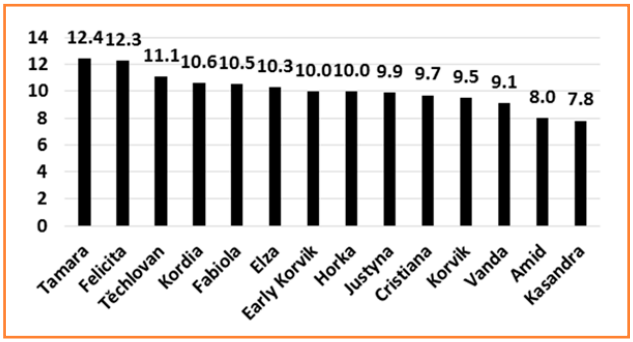

Figure 2 Evaluation of fruit weight (g)

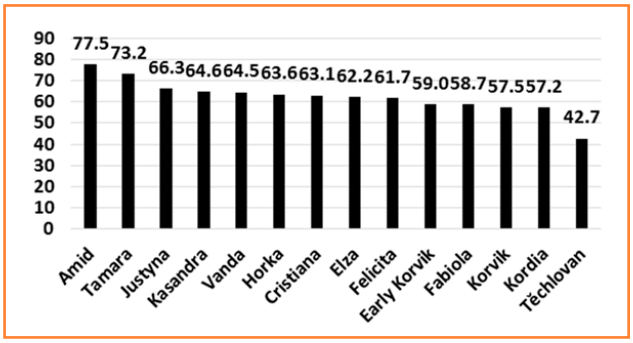

Figure 3 Evaluation of fruit firmness (index 1–100)

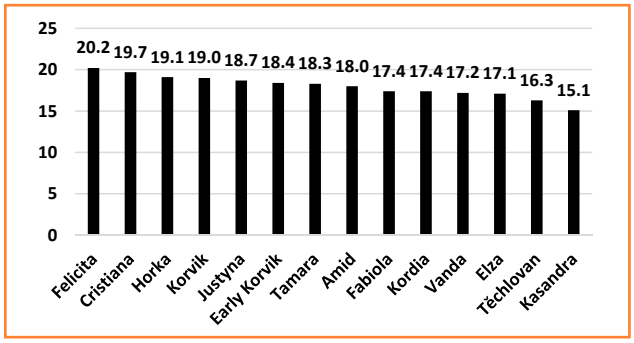

Figure 4 Evaluation of SSC (°Brix)

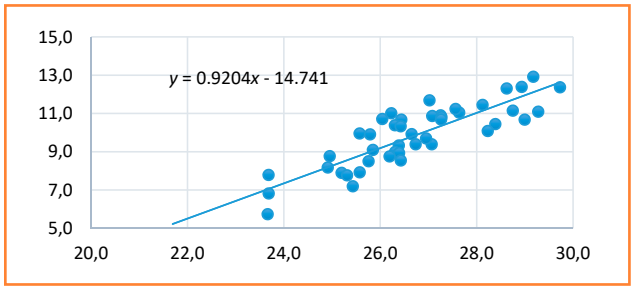

Figure 5 Dependence of fruit size and fruit weight

Correlation between fruit characteristics

High correlation between fruit characteristics (table 2) was found only between weight and width of fruits (correlation coefficient 0.88). This dependence can be described using the linear regression function $y = 0.9204x - 14.741$ (Figure 5). Medium dependence was found between the fruit weight and the fruit SSC (correlation coefficient 0.53). Low dependence was recorded in the relation fruit weight – fruit firmness (correlation coefficient 0.35), size – SSC (correlation coefficient 0.33) and size – firmness (correlation coefficient 0.38).

Conclusion

The results point to large year on year differences in fruit weight, size, SSC and firmness and also differences among the tested cultivars. In 2017, the fruits of all cultivars reached higher weight and fruit size than in 2018. The cause of the small yields in 2017 is frost damage during the tree flowering period; the fruit set was reduced. As a result of frost damage, the fruit set was lower in 2017 which was reflected in their higher weight and size. The lower weight and size of fruits in 2018 can be explained by very warm and dry weather, when the fruits of all cultivars ripened very quickly and the period was not long enough to grow to the size and weight as in 2017.

The records showed differences in fruit firmness between years and among the tested cultivars. Differences in fruit firmness among the cultivars indicate the differences in their cell structures, skin characteristics, compositions and/or respiration rates (Karacali, 2012). The highest sizes of fruits (29 mm and more) were achieved by the cultivars ´Tamara', ´Horka', and the newly registered cultivar ´Felicita'. The weight of fruits over 12 g was recorded in the cultivars ´Tamara', ´Horka' and ´Felicita', which confirms the high quality of the breeding programme of sweet cherries at Holovousy that is focused on selection and creation of high fruit size cherry cultivars. Fruit firmness of ´Amid´ and 'Tamara´ was higher than that of the other cultivars.

The differences in fruit characteristics among the cultivars observed in this evaluation of tested cultivars are in accordance with the observation of Sen et al., 2014 which includes differences in fruit quality during storage and transportation to consumers. Breeding programme and selection of new cultivars should be also focused on high ability of cherry fruits to long term storage and long shelf life.

Acknowledgements

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