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Influence of rootstocks on size distribution and fruit quality of sweet cherry cultivars

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A b s t r a c t. In the cherry rootstock trials at Ullensvang, Norway the following quality prameters of sweet cherry cultivars: Van, Ulster and Burlat on seedling, Colt and Gisela 5 were evaluated: mean fruit weight, content of soluble solids, acidity, flesh firmness and percentage of fruit in individual size classes. The above quality parameters fluctuated markedly during the experimental summer period of 1998. Individual cultivars responded in various ways to the kind of rootstock. The kind of rootstock exerted a significant influence on the individual factors determining fruit quality. It significantly influenced fruit external features, i.e., their size and percentage of stone in total fruit weight. The largest fruit of cv. Van noticed on seedling rootstock, cv. Ulster - on Colt and cv. Burlat - on Gisela 5. However the largest stone-weight per total fruit-weight in all cultivars studied was in fruits from trees on Gisela 5. The fruits of all cultivars reacted with different firmness depending on the kind of rootstock. The firmest fruits on seedling and Gisela 5 rootstock stated at cv. Ulster. However the Colt fruits of cv. Van had the greatest firmness. Fruits of cv. Burlat characterized the lowest values of firmness compared to the rest of the cultivars studied. The internal fruit features described by the amount of soluble solids, titratable acidity and pH of fruits juice was determined by the kind of rootstock.

K e y w o r d s: fruit quality, sweet cherries, rootstock

INTRODUCTION

In order to find an objective rootstocks for cultivars Van, Ulster and Burlat, a preliminary investigation was carried out to determine the effects of rootstock on fruit quality.

Intensive planting systems, utilizing dwarf trees is necessary in modern orchards [13]. Such systems are highly productive and also easier to manage and to harvest than the more extensive systems with larger trees. Much of the reduction in tree size, necessary for the success of high density planting systems is achieved using dwarfing rootstocks [11]. Rootstocks which are dwarfing and which also induce precious and consistent cropping of high quality fruit are not yet fully developed for the sweet cherry. Unlike apple, where clonal rootstocks of the same species as the scion (*Malus pumila*) have been selected to provide a range of vigor control, no successful dwarfing rootstocks have been yet found within the sweet cherry species (*Prunus avium* L). The modernist rootstocks are closely allied *Prunus* species or from bispecific hybrids between these species (for example Colt is a hybrid between *Prunus avium* and *Prunus pseudocerasus*). Beside the influence on the tree vigor, rootstock could modify fruit quality [7]. Quality factors for fresh fruit were defined by Kader [4] as: hygiene and quarantine (spray residues, heavy metals), cosmetic appearance (size, weight, shape), texture (firmness, hardness/ softness), flavor (sweetness, sourness) and nutritional factors. Consumers have different preference to the quality criteria governing their choice of fruits [12]. For example Norwegian consumers rate the internal quality of sweet cherries higher than their external quality, while consumability and nutritive value are of little importance. Size and color are of less importance. Flavor is the most important internal quality factor. Texture comes second and is of higher importance to pears than plums and sweet cherries. There are different way of determining fruit quality [4,8]. One of them is the measurement of physical properties [2,3,9,14]. The quality of all kinds of berries, which contain a high percentage of water decreases almost immediately during transport and storage, especially if they are overripe or the variety is liable to damage [9]. Prevention of such phenomena is closely connected with the recognition of physical properties in agricultural material [3]. A very important group of physical properties are the mechanical

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properties, which are defined as the material's susceptibility to damage and the influence of various external factors during harvest, transport, storage and processing [9]. Although researchers developed relationships between physical properties and quality factors for a number of horticultural produts, firmness is the property that is ofen used for evaluating fruit quality [1,5,6,10].

Objectives of this research were:

1) to evaluate the influence of different rootstock on the fruit quality of the individual sweet cherry cultivar with special reference to the firmness of the fruit;

2) to estimate the most favorable rootstock for producing fruits of cultivars Van, Ulster and Burlat with the best quality.

MATERIALS AND METHODS

The experiment was carried out in Lofthus (Norway) in1998 on trees planted in 1980. The planting distance was 5.5 x 4 m. Single-tree plots were used in a split-plot design with cultivars (Van, Ulster, Burlat) on the main plots and rootstocks (seedling, Gisela 5, Colt) on sub-plots with four replications. The trees were trained as free spindle and tree height was kept at 3 m by pruning. The soil was a loamy sand, high in organic matter (6.7%). The pathways were kept under grass, which was frequently mown. Along the trees rows were herbicide stripes - 1 m broad. No drip irrigation was provided as average rainfall in the area is 428 mm during the growing season (May 50 mm, June 59 mm, July 74 mm, August 86 mm, September 159 mm). At normal harvest time, random samples of 100 fruits were picked from each tree. The samples cherries were representative of the crop of the total tree, with an equal degree of ripeness.

The fruit sample was divided for groups of each 1 mm fruit size. Annual records of percentage fruit size distribution, mean fruit weight, content of soluble solids, acidity and fruit firmness were taken. Titratable acidity was determined by titrating diluted juice samples to pH 8.1 by 0.01 N NaOH. The fruit firmness was determined by Durofel/ Penefel Software Basis Version 1.3. The content of soluble solids was measured by an Atago digital refractometer. The results were statistically evaluated and Tuckey's test at 5% level was employed to separate means.

RESULTS

Fruit quality examination, measuring the important quality criteria such as flesh firmness revealed differences between cherries produced on the different rootstocks. Fruit quality from trees from seedlings as measured by the flesh firmness was affected by cultivars (Fig. 1). Flesh firmness of fruits from trees on seedling was the best for cv. Ulster mean 4.07 kPa and the lowest - for cv. Burlat mean 1.06 kPa.

The best flesh firmness of fruits from trees of cv. Van was stated at 26 mm of fruits diameter and the lowest - at 28 mm of fruits diameter. The flesh firmness of fruits of cv. Ulster was best in 22 mm of fruits' diameter, however it slightly decreased with increasing in size of fruits by 1 mm (to 27 mm of fruits' diameter). The best flesh firmness of fruits of cv. Burlat was at 22 mm of fruits' diameter. The flesh firmness of fruits with 21 to 26 mm of their diameter varied between 1.0-1.3 kPa, however fruits at 27 mm of diameter had the lowest value of flesh firmness (below 1.0 kPa). The largest fruits of all the studied cultivars from trees from seedlings had the lowest flesh firmness.

It is evident that the best firmness from trees on Colt had fruits of cv. Van - 3.6 kPa, however the lowest - cv. Burlat - 1.16 kPa (Fig. 2). The values of flesh firmness of fruits of cv. Van at the individual classes of their size were inconsistent. The firmest fruits were stated at 22 mm of their diameter, however the least firm fruits were at 27 mm of the fruits' diameter. Fruits size of cv. Ulster greatly influenced the flesh firmness of the fruits. Opposite to cv. Van, fruits of cv. Ulster had the best firmness at 27 mm of their diameter - 3.08 kPa, however the lowest - at 22 mm of fruits' diameter - 2.68 kPa. The best flesh firmness of fruits of cv. Burlat was at 24

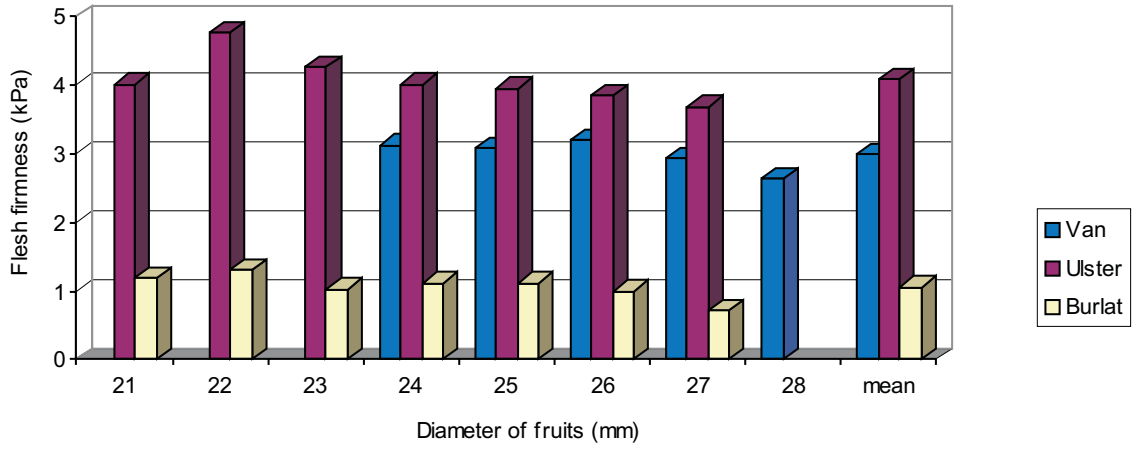

Fig. 1. The influence of seedling rootstock on flesh firmness of cherries cv. Van, Ulster and Burlat.

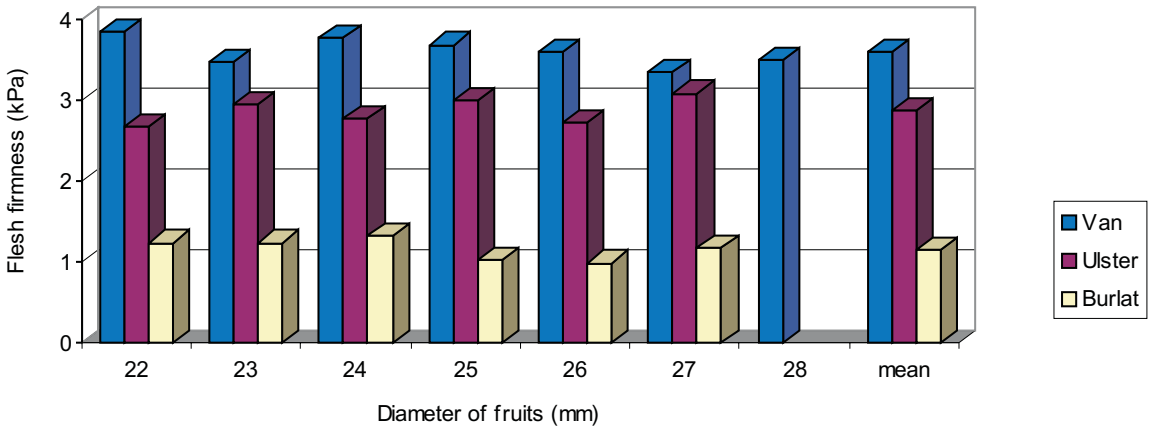

Fig. 2. The influence of Colt rootstock on flesh firmness of cherries cv. Van, Ulster and Burlat.

mm of fruits' diameter, however the lowest - at 26 mm of fruits' diameter.

Based on results such as those presented in Fig. 3 the greatest mean value of fruits, flesh firmness on Gisela 5 had fruits of cv. Ulster - 3.8 kPa, however the lowest - of cv. Burlat - 1.15 kPa. The fruit size reflected significant differences in flesh firmness of cv. Van. Under such conditions a slightly negative response of increasing in fruits' size from 24 to 29 mm of fruits' diameter to their flesh firmness was found. The values of flesh firmness of cv. Ulster decreased with increasing in fruits' size from 5 kPa at 22 mm of their diameter to 2,84 kPa at 26 mm of their diameter. The Fig. 3 indicates that the flesh firmness of fruits of cv. Burlat slightly increased with increasing in fruits' diameter from 1.06 kPa (at 23 mm of fruits' diameter) to 1.26 kPa (at 28 mm of fruits' diameter).

The biggest fruits (diameter of fruits 24 - 29 mm) of cv. Van, dependent of rootstocks had trees on seedling (Table 1). Cherries from trees on Colt was very different in their size, however the greater part of them had a diameter of 25 mm - 19.8%. Trees cv. Van - on Gisela 5 were different in fruit size too, but the greater part of them had a diameter of 23 mm -17.5%. The mean fruit weight of cv. Van grown on seedling, Colt and Gisela 5 was 9.15, 8.30, and 7.61, respectively.

According to increasing the fruits' diameter by 1 mm, the percentage weight of the stone to the total fruit weight decreased from 5.50% at the diameter of fruit 21 mm to 3.47% at the diameter of fruit 29 mm. There was no effect of rootstocks on value of this feature in cv. Van's fruits. The mean percentage weight of stone to total fruit weight was 4.18-4.54%.

The best mean soluble solids of fruits was from trees cv. Van at diameter of fruits 24 mm - average 20.63% and the

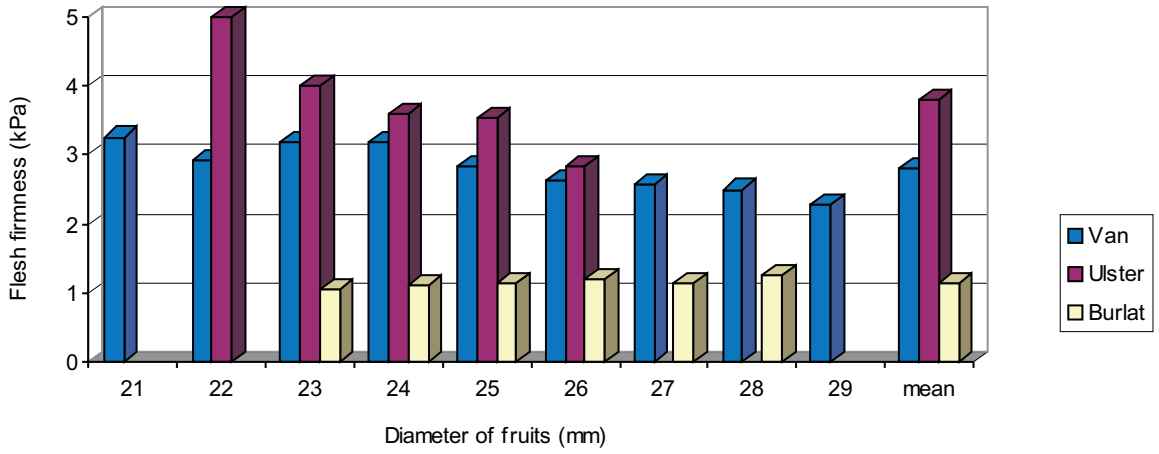

Fig. 3. The influence of Gisela 5 rootstock on flesh firmness of cherries cv. Van, Ulster and Burlat.

lowest at the diameter of fruit 29 mm - average 17.20% (Table 1). Fruits from trees Van - on Colt had the best soluble solids - average 20.68% and from trees Van - on seedling - the lowest - average 18.78%.

The heights mean amount of acid (titratable acidity) stated in Van at diameter of fruits 25 mm - average 0.474% and the lowest - at the diameter of fruits 21 mm - average 0.393%. The heights mean acidity was in fruits of Van - on Colt - average 0.498% and significant lower in Van - on Gisela 5 - average 0.408%.

The heights pH was in fruits of Van at diameter of fruits 21 mm - average 4.32, and the lowest at diameter of fruits 29 mm - average 4.12. There was no influence of rootstock on pH of the juice of the fruit and their values was 4.10 - 4.29.

The most regular fruits in their size of cv. Ulster produced trees grown on Gisela 5 - diameter of fruits was from 22 to 26 mm (Table 2), but the greater part of the fruit was in group at 24 mm of fruits diameter (33.7%). Percentage of fruits with diameter above 24 mm, was 78.2%. Fruits from trees cv. Ulster - on seedling were very different in their size, however the largest amount of them was in the group with 27 mm of fruits diameter - 19.4%. The percentage of fruits above diameter 24 mm was 70.5%.

The mean fruit weight was influenced by rootstock. The largest mean fruit weight stated from trees cv. Ulster grafted on Colt - 8.09 g and the smallest from trees grafted on seedling - 7.52 g, however fruits produced by the trees of Ulster - on seedling were very different in their size and mean fruit weight was 4.9 to 10.14 g.

Percentage part of stone weight in total fruit weight decreased with the increasing diameter of fruits by 1 mm from 5.67% (at 22 mm diameter of fruits) to 4.41% (at 27 mm diameter of fruits). The largest values of that features noted in fruits from trees cv. Ulster - on Gisela 5 - average 5.11% and the lowest - from trees cv. Ulster - on seedling - average 4.87%.

Measurement of soluble solids revealed increasing with increase in fruit diameter by 1 mm from 15.07% (at 22 mm diameter of fruits) to 16.17 (at 26 mm diameter of fruits) (Table 2). There was no effect of rootstocks - the seedling and Colt on amount of soluble solids - average was 15.10% and 15.03% respectively, but fruits from trees cv. Ulster - on Gisela 5 had significantly higher content of soluble solids - average 17.26%.

The influence of fruit size on the content of acid in fruits of cv. Ulster was inconsistent. The best acidity was found in fruits at a diameter of 25 mm - 0.405%, and the lowest - at a diameter of 24 mm - 0.367%. There was no difference in the acid content of fruits of Ulster - on Colt and Gisela 5 - 0.369% and 0.362%, respectively. Fruits from Ulster grown from seed had a significant higher content of acid - 0.431%.

The pH of fruit juice of cv. Ulster decreased with increasing fruit diameter by 1 mm from 4.40 at diameter of fruits 22 mm to 4.26 - at diameter of fruits 27 mm. There was no influence of rootstock: (seedling and Colt) on pH of fruit juice - 4.25 and 4.29, respectively, but cherries from trees on Gisela 5 had a significantly higher value of this feature.

The percentage size distribution of fruits of cv. Burlat was studied too (Table 3). The most different fruits in their size was that from seedlings - the diameter of fruits was 21 to 29 mm, but the greater part of the fruits was in group at 24 mm of fruits diameter - 28.5%. The fruits size (determined by their diameter) on Gisela 5 was from 23 to 29 mm and a great amount of it had fruits of 26 mm in diameter - 25.4%, although fruits of Burlat - on Colt were more similar in size and varied from 22 mm to 27 mm of fruits diameter, and the greater part of the fruits was in group at 25 mm of their diameter - 27.5%.

The mean fruit weight of cv. Burlat, independent of rootstock, was from 5.43 to 10.59 g. The average of mean fruit size, dependent on rootstock was 7.36, 7.48, and 8.39 g (on seedling, Colt and Gisela 5, respectively). However comparing the mean fruit weight in individual group of their size stated that trees on seedlings produced the heaviest fruits.

According to increasing fruit size by 1 mm the percentage part weight of stone in total fruit weight was decreased-average from 3.05% (at 22 mm of fruits diameter) to 2.36% (at 28 mm of fruits diameter). The biggest values of this features stated in fruits at 22 mm of their diameter - 3.19% and the lowest - at 27 mm of their diameter - 2.26%. Depending on the rootstock, the quite small percentage part of the weight of the stone in the total fruit weight stated in fruits from trees cv. Burlat - on Colt - average 2.70% and the biggest in fruits of cv. Burlat - on Gisela 5 - average 2.84%.

The best soluble solids were in fruits at 23 mm of their diameter - average 17.17% and the lowest - at 27 mm of fruits diameter - average 14.90% (Table 3). The great influence on the content of soluble solids of. cv. Burlat fruits had the seedling rootstock - average 17.18 %, and the poorest - the Colt - average 14.47%.

The heights amount of acid was to be found in fruits from trees of cv. Burlat at 25 mm of their diameter - average 0.502% and the lowest - at 28 mm - average 0.432%. The best effect of rootstock on acidity of fruits was to be found in the the Colt - average 0.485% and fruits from trees Burlat - on Gisela 5 have significant lower amount of acid - average 0.456%.

There was no significant influence of rootstocks on pH of fruit juice and it was from 4.27 to 4.40. The fruits of cv. Burlat had the higher pH at 22 and 23 mm of their diameter - 4.53 and 4.44, respectively.

DISCUSSION

The kind of rootstock had the great influence on number of fruits in individual classes of fruit size. The greater part of fruits from trees of. cv. Van grown on seedling was in group at 26 mm of fruit diameter, Ulster - at 27 mm of fruit diameter and Burlat - at 24 mm of fruit diameter.

T a b l e 1. Some factors influencing on fruits' quality of cv. Van on three different rootstocks

Studied factors	Rootstocks	Diameter of fruit (mm)									Average
		21	22	23	24	25	26	27	28	29	
Percentage number of fruits (%)	Seedling	0.0 a	0.0 a	0.0 a	8.9 a	21.4 a	27.8 a	25.5 b	11.2 a	5.2 b	
	Colt	0.0 a	12.0 b	11.2 b	15.2 b	19.8 a	18.6 a	13.3 a	10.0 a	0.0 a	
	Gisela 5	9.7 b	16.5 c	17.5 c	9.2 ab	13.0 a	14.7 a	12.3 ab	7.1 a	0.0 a	
	Average	**3. 2**	**9.5**	**9.6**	**11.1**	**18.1**	**20.4**	**17.0**	**9.4**	**1.7**	
Mean fruit weight (g)	Seedling	-	-	-	7.25 ab	7.98 a	8.68 a	9.45 a	10.32 a	11.23	9.15 b
	Colt	-	5.96 b	6.81 b	7.55 b	8.21 a	8.95 b	9.88 b	10.71 a	-	8.30 ab
	Gisela 5	5.09	5.68 a	6.31 a	7.03 a	7.86 a	8.69 a	9.50 a	10.68 a	-	7.61 a
	Average	**5.09**	**5.82**	**6.56**	**7.28**	**8.02**	**8.77**	**9.61**	**10.57**	**11.23**	
Percentage part weight of stone in total fruit weight (%)	Seedling	-	-	-	4.69 b	4.64 b	4.38 b	4.23 b	4.07 b	3.47	4.25 a
	Colt	-	4.87 a	4.55 a	4.37 a	4.14 a	4.02 a	3.74 a	3.55 a	-	4.18 a
	Gisela 5	5.50	5.28 b	5.06 b	4.47 ab	4.33 ab	4.14 ab	4.00 ab	3.56 a	-	4.54 a
	Average	**5.50**	**5.08**	**4.81**	**4.51**	**4.37**	**4.18**	**3.99**	**3.73**	**3.47**	
Soluble solids (%)	Seedling	-	-	-	20.38 a	19.63 a	18.85 a	18.78 a	17.83 a	17.20	18.78 a
	Colt	-	21.00 b	21.83 b	21.68 a	20.93 a	20.08 b	19.48 a	19.78 b	-	20.68 b
	Gisela 5	18.88	18.30 a	18.38 a	19.83 a	19.90 a	19.33 ab	19.38 a	19.48 b	-	19.19 ab
	Average	**18.88**	**19.65**	**20.11**	**20.63**	**20.15**	**19.42**	**19.21**	**19.03**	**17.20**	
Titratable acidity (%)	Seedling	-	-	-	0.518 b	0.485 ab	0.484 b	0.459 ab	0.459 ab	0.469	0.479 ab
	Colt	-	0.507 b	0.496 b	0.496 b	0.506 b	0.511 b	0.484 b	0.484 b	-	0.498 b
	Gisela 5	0.393	0.387 a	0.401 a	0.371 a	0.431 a	0.417 a	0.430 a	0.430 a	-	0.408 a
	Average	**0.393**	**0.447**	**0.449**	**0.462**	**0.474**	**0.471**	**0.458**	**0.458**	**0.469**	
pH	Seedling	-	-	-	4.13 a	4.09 a	4.04 a	4.15 a	4.06 a	4.12	4.10 a
	Colt	-	4.15 a	4.22 a	4.23 ab	4.19 ab	4.15 b	4.20 a	4.16 b	-	4.19 a
	Gisela 5	4.32	4.29 b	4.26 a	4.39 b	4.24 b	4.28 c	4.27 a	4.26 c	-	4.29 a
	Average	**4.32**	**4.22**	**4.24**	**4.25**	**4.17**	**4.16**	**4.21**	**4.16**	**4.12**	

Means within each column followed by the same letter do not differ significantly at $\alpha = 0.05$, test Tuckey'a.

T a b l e 2. Some factors influencing on fruits' quality of cv. Ulster on three different rootstocks

Studied factors	Rootstocks	Diameter of fruit (mm)							Average
		21	22	23	24	25	26	27	
Percentage number of fruits (%)	Seedling	3.7 b	13.2 b	12.7 a	18.3 a	14.3 a	18.5 b	19.4 c	
	Colt	0.0 a	7.3 a	14.5 a	27.2 ab	24.3 b	19.0 b	7.7 b	
	Gisela 5	0.0 a	13.2 b	24.4 b	33.7 b	20.5 b	8.3 a	0.0 a	
	Average	**1.2**	**11.2**	**17.2**	**26.4**	**19.7**	**15.3**	**9.0**	
Mean fruit weight (g)	Seedling	4.90	5.84 a	6.54 a	7.58 a	8.35 a	9.26 a	10.14 a	7.52 a
	Colt	-	6.10 b	6.86 a	7.64 a	8.49 a	9.14 a	10.28 a	8.09 b
	Gisela 5	-	6.04 ab	7.08 b	7.86 b	8.66 b	9.58 b	-	7.84 ab
	Average	**4.90**	**5.99**	**6.83**	**7.69**	**8.50**	**9.33**	**10.21**	
Percentage part weight of stone in total fruit weight (%)	Seedling	5.29	5.14 a	5.00 a	4.92 a	4.79 a	4.64 a	4.34 a	4.87 a
	Colt	-	5.90 b	5.54 b	5.10 b	4.95 b	4.70 a	4.47 a	4.87 a
	Gisela 5	-	5.96 b	5.65 b	5.34 b	5.31 c	4.91 b	-	5.11 ab
	Average	**5.29**	**5.67**	**5.40**	**5.12**	**5.02**	**4.75**	**4.41**	5.43 b
Soluble solids (%)	Seedling	-	15.50 ab	13.50 a	15.20 a	15.40 a	15.70 a	15.30 a	15.10 a
	Colt	-	13.30 a	14.80 ab	14.90 a	15.35 a	15.60 a	16.20 a	15.03 a
	Gisela 5	-	16.40 b	17.70 b	17.40 b	17.60 b	17.20 b	-	17.26 b
	Average	-	**15.07**	**15.33**	**15.83**	**16.12**	**16.17**	**15.75**	
Titratable acidity (%)	Seedling	-	0.416 b	0.415 b	0.404 b	0.448 b	0.448 b	0.457 b	0.431 b
	Colt	-	0.370 a	0.377 a	0.373 ab	0.382 a	0.362 a	0.350 a	0.369 a
	Gisela 5	-	-	0.351 a	0.323 a	0.386 a	0.386 a	-	0.362 a
	Average	-	**0.393**	**0.381**	**0.367**	**0.405**	**0.399**	**0.404**	
pH	Seedling	-	4.40	4.21 a	4.25 a	4.19 a	4.22 a	4.21 a	4.25 a
	Colt	-	-	4.42 b	4.22 a	4.24 a	4.24 a	4.31 b	4.29 a
	Gisela 5	-	-	4.54 c	4.60 b	4.44 b	4.36 b	-	4.49 b
	Average	-	**4.40**	**4.39**	**4.36**	**4.29**	**4.27**	**4.26**	

Explanations as in Table 1.

T a b l e 3. Some factors influencing on fruits' quality of cv. Burlat on three different rootstocks

Studied factors	Rootstocks	Diameter of fruit (mm)									Average
		21	22	23	24	25	26	27	28	29	
Percentage number of fruits (%)	Seedling	0.9 b	7.3 b	21.5 b	28.5 b	24.3 a	10.8 a	4.7 a	0.9 a	0.9 b	
	Colt	0.0 a	6.9 b	20.5 b	26.8 b	27.5 a	12.7 a	5.6 a	0.0 a	0.0 a	
	Gisela 5	0.0 a	0.0 a	6.9 a	14.2 a	24.6 a	25.4 b	19.0 b	9.0 b	0.9 b	
	Average	**0.3**	**4.7**	**16.3**	**23.2**	**25.2**	**16.3**	**9.8**	**3.3**	**0.6**	
Mean fruit weight (g)	Seedling	5.43	5.95 a	6.72 ab	7.36 a	8.09 a	8.71 a	9.29 b	-		7.36 a
	Colt	-	5.84 a	6.50 a	7.08 a	7.85 a	8.43 a	9.16 a	-		7.48 a
	Gisela 5	-	-	6.94 b	7.35 a	7.85 a	8.48 a	9.10 a	10.59		8.39 b
	Average	**5.43**	**5.90**	**6.72**	**7.26**	**7.93**	**8.54**	**9.18**	**10.59**		
Percentage part weight of stone in total fruit weight (%)	Seedling	-	3.19 b	2.98 ab	2.85 a	2.72 ab	2.41 a	2.26 a	-		2.74 a
	Colt	-	2.91 a	2.87 a	2.82 a	2.68 a	2.49 a	2.40 ab	-		2.70 a
	Gisela 5	-	-	3.17 b	3.13 b	2.93 b	2.83 b	2.64 b	2.36		2.84 b
	Average	-	**3.05**	**3.01**	**2.93**	**2.78**	**2.58**	**2.43**	**2.36**		
Soluble solids (%)	Seedling	-	18.68 b	18.60 b	17.60 b	16.60 b	15.50 a	16.10 c	-	-	17.18 c
	Colt	-	15.50 a	14.83 a	13.73 a	14.78 a	14.58 a	13.40 a	-	-	14.47 a
	Gisela 5	-	-	18.08 b	16.95 b	16.55 b	15.75 a	15.20 b	15.40	-	16.32 b
	Average	-	**17.09**	**17.17**	**16.09**	**15.98**	**15.28**	**14.90**	**15.40**	-	
Titratable acidity (%)	Seedling	-	0.473.b	0.463 b	0.469 a	0.487 a	0.442 a	-	-	-	0.467 ab
	Colt	-	0.444 a	0.510 c	0.513 b	0.500 a	0.485 b	0.455 a	-	-	0.485 b
	Gisela 5	-	-	0.367 a	0.497 ab	0.518 a	0.463 ab	0.460 b	0.432	-	0.456 a
	Average	-	**0.459**	**0.447**	**0.493**	**0.502**	**0.463**	**0.458**	**0.432**	-	
pH	Seedling	-	4.56 a	4.37 b	4.35 b	4.31 b	4.39 a	4.43 c	-	-	4.40 a
	Colt	-	4.49 a	4.23 a	4.20 a	4.24 ab	4.22 a	4.32 b	-	-	4.28 a
	Gisela 5	-	-	4.72 c	4.28 ab	4.12 a	4.21 a	4.13 a	4.18	-	4.27 a
	Average	-	**4.53**	**4.44**	**4.28**	**4.22**	**4.27**	**4.29**	**4.18**	-	

Explanations as in Table 1.

The best amount of large fruits (with 26 mm of diameter) was from trees Burlat - on Gisela 5, but cv. Van and Ulster had the great part of its yield in group at 23 and 24 mm of fruit diameter.

Van seedling rootstock had the most favorable influence on mean fruit weight from the trees; however for Ulster the most suitable was Colt and for Burlat - on Gisela 5. The vegetative rootstock has more positive effect on mean fruit weight of cv. Burlat, which was confirmed by the study of Ugolik and Kantorowicz-Bąk [11].

Fruit flesh firmness is a very important quality factor in fruit for storing or long-distance transport. The kind of rootstock had an influence on this feature. It was stated that fruits with the best mean fruit weight, obtained from trees cv. Van and Ulster - on seedling or Colt, characterized the lowest value of flesh firmness, although the fruit flesh firmness of cv. Burlat - on Colt was the best in average mean weight of fruit.

Similarly, fruit size and the size of the stone is a feature which is modified by the cultivar. The greatest percentage part of the weight of the stone in total fruit weight was produced by fruits of cv. Ulster and the lowest - Burlat. There was some effect of rootstock on it too. The greatest value of this feature was in fruits from trees all cultivars grown on Gisela 5.

Besides, external factors, which could determining fruit quality, the essential meaning have the chemical properties of fruit juice. The test of fruits depends on the content of soluble solids, acidity, pH of juice and another internal factors. The fruits of Van, having the best soluble solids, were from trees grown on Colt, but fruits of cv. Ulster - on Gisela 5 and Burlat - on seedling. The good quality of sweet cherries is influenced by the right proportion of both sugar and acid. The fruits of cv. Van and Burlat had the greatest amount of acid from trees grown on Colt, but Ulster - on seedling.

Among cultivars there were no differences in the influence of rootstock on pH of fruit juice. Only fruits of cv. Ulster - on Gisela 5 had any significant higher value of pH of fruit juice comparing to the fruits of this cultivar on seedling or Colt.

CONCLUSIONS

1. The individual cultivars respond in different ways according to the kind of rootstock. The kind of rootstock has a great influence on individual factors in determining fruit quality.

2. The kind of rootstock significantly influenced the external features of fruits - their size and the percentage part of the weight of the stone per total fruit weight. The biggest fruits of cv. Van noticed on seedling rootstock, cv. Ulster - on Colt and cv. Burlat - on Gisela 5. However the largest part the weight of the stone per total fruit weight in all cultivars studied was in fruits from trees on Gisela 5.

3. The fruits of all cultivars reacted with different firmness depending on the kind of rootstock. The firmest fruits on seedling and Gisela 5 rootstock stated at cv. Ulster. However on Colt fruits of cv. Van had the greatest firmness. Fruits of cv. Burlat characterized the lowest values of firmness compare to rest of the cultivars studied.

4. The internal features of the fruits, described by the amount of soluble solids, titratable acidity and pH of fruits juice, was determined by the kind of rootstock.

5. The greatest amount of soluble solids in fruits of cv. Van noticed on Colt, cv. Ulster - on Gisela 5 and cv. Burlat - on seedling. Fruits of cv. Van had more soluble solids compare to cv. Ulster and Van.

6. The kind of rootstock influenced on amount of titratable acidity in fruits of studied cultivars. The greatest amount of them stated in fruits of cv. Van - on Colt, cv. Ulster - on seedling and cv. Burlat - on Colt. Fruits of cv. Ulster had a lower amount of titratable acidity compared to cv. Van and Burlat.

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