

BIOMETRIC PARAMETERS OF FRUITS AND STONES OF NEWLY INTRODUCED FLAT FRUIT PEACH CULTIVARS - *PRUNUS PERSICA* (L.) BATSCH. *F. COMPRESSA*

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Abstract

In this paper, a comparative analysis is made of the basic biometric characteristics of fruits and stones from 4 newly introduced cultivars of peaches and one nectarine belonging to *Prunus persica* (L.) Batsch. (*f. compressa*) (Flat fruit peach), selected in France ('Platibelle' and 'Mesembrine'), Italy ('UFO-4') and Spain ('ASF-2-80' and 'Flat Queen'). In Bulgaria they were imported from Spain in 2009. They are being studied in a collection plantation of the Fruit Growing Institute - Plovdiv. The highest value of fruit weight is measured for the 'Flat Queen' fruits – 136.01 g, and the smallest of the fruits are of the nectarine cultivar 'Mesembrine' - 65,24 g. It is established that in cultivars with flat-shaped fruits, the largest size is the thickness of the fruit, and the smallest is the height. The stones are small and range from 2.44 g in 'UFO-4' fruit to 3.35 g in 'Flat Queen'. The relative share of the stone compared to the total fruit weight is also low and ranges from 2.26% for 'ASF-2-80' to 4.91% for 'Mesembrine'. The relationship between the three fruit sizes (coefficient or index) indicates how much the shape of the fruit is closer or different than the sphere. In the sample group of cultivars close to or equal to 1 is only the width / thickness index, since the two sizes are of similar size.

Keywords: *Prunus persica f. compressa*, flat, fruit, peach, biometry.

Introduction

Recent trends in the consumer preferences encourage the development of “new” types and products to diversify the market. In response, breeders are focusing more efforts on developing cultivars with higher fruit quality and better diversity of fruit types to market (Byrne, 2002). Although flat peaches have been grown in China for centuries (Ma, 2003), until recently their widespread commercial use has been limited due to a lack of firmness and cracking problems (Byrne, 2005).

In the last 10-15 years, peaches with a flat-fruit shape have been spreading rapidly in Europe and North America. They have a growing share in new production plantations, due to the significantly higher market prices and their sweet taste compared to peaches with globular fruits.

In the study of organoleptic characteristics, antioxidant activity and levels of antioxidant compounds, Di Vaio et al. (2014) surveyed eight commercial cultivars

of peach and nectarine. Flat peach and nectarine fruits had better organoleptic characteristics (mainly higher SSC) and higher nutritional profiles than standard peach and nectarine fruits.

In Bulgaria, flat fruit peaches were known for more than 30 years when a small number of old cultivars were grown only in the collections of the Fruit Growing Institute - Plovdiv and the experimental station in Pomorie. Nowadays this group of peaches and nectarines has a growing interest and the first production plantations in the country are being created.

The purpose of this study is to establish the basic biometric parameters of the fruits and stones of four new cultivars of peaches and one nectarine.

Material and methods

The study included four new cultivars of peach and one nectarine belonging to *Prunus persica* (L.) Batsch. (*f. compressa*), selected in France ('Platibelle' and nectarine 'Mesembrine'), Italy ('UFO-4') and Spain ('ASF-2-80' and 'Flat Queen'). In Bulgaria, they were introduced from Spain in 2009.

The surveys were carried out at a collection plantation (GSP 42°06'09.8"N 24°43'04.3"E) of the Fruit Growing Institute - Plovdiv in the period 2013-2016. Trees of all tested cultivars are grafted on a traditional peach seedling rootstock. They are grown at a distance of 5x3 m, the crowns being formed by the free-growing training system.

Each year, average samples of 25 fruits and 10 stones are tested. Biometric data processed statistically by using the method developed by David B. Duncan (Duncan, 1955) using the restated in 1960 in Air Force Base Wright-Patterson, critical values for the test (Harter, 1960). The software used in the study is R-3.1.3 and RStudio-0.98.

Results and discussion

The specific shape of the fruits of the tested group of peaches determines significantly different sizes than those of the traditional round-shape cultivars.

As a result of the 4-year research, it was established that the largest size in the fruit was the thickness (Table 1). The same ranges from 56.54mm (nectarine cultivar 'Mesembrine') to 74.65 mm (peach cultivar 'ASF-2-80'), this difference is statistically proven. A proven statistical difference is also found between the values of the cultivar 'Mesembrine' on the one hand and those of the 'Flat Queen' and 'UFO-4' on the other. The difference between the thickness and height of the fruit in the cultivar 'ASF-2-80' is almost double. The width of the fruit is very slightly lower than the thickness of all the cultivars studied. The widest are the fruits of 'Flat Queen' - 73.77mm, followed by the cultivar 'ASF-2-80' - 73.26 mm. The smallest is the width of the fruit of 'Mesembrine' - 56.20 mm. It was found that the height of the fruit for the whole group of studied cultivars was the smallest and ranged from 34.88 mm in the case of 'UFO-4' fruits to 43.67 mm in those of 'Flat

Queen'. The differences are statistically proven between the value of 'Flat Queen' and that of each of the cultivars 'Mesembrine', 'Platibelle' and 'UFO-4'.

According to the established fruit weight, the largest fruits were those of 'Flat Queen' - 136.01 g, followed by the fruits of 'ASF-2-80' - 119.43 g. Smallest are the fruits of the 'Mesembrine' cultivar - 65.24 g. The weight of 'UFO-4' and 'Platibelle' fruits occupies an intermediate position of 93.36 g and 84.72 g, respectively. It is known that peaches cultivars of a traditional rounded fruit form exhibit much higher values of the fruit weight, i. e. the fruits of flat-shape cultivars are considerably smaller.

Table 1. Average size [mm] and weight [g] of the fruits – 2013-2016

CULTIVAR	Fruit height [mm]	Fruit width [mm]	Fruit thickness [mm]	Fruit weight [g]
ASF-2-80	37.83 ab	73.26 ab	74.65 a	119.43 ab
FLAT QUEEN	43.67 a	73.77 a	73.88 a	136.01 a
MESEMBRINE	36.29 b	56.20 c	56.54 b	65.24 c
PLATIBELLE	35.99 b	62.46 bc	64.78 ab	84.72 bc
UFO-4	34.88 b	66.76 abc	67.89 a	93.36 abc

For most of the stone fruit species, the height is the largest stone size. For peach cultivars with flat fruit shape, the stones have a very specific shape. Studies have shown that the height is the smallest of the three sizes of the stone, and the values are significantly lower than those of the other two dimensions (Table 2). Observations have shown that often the tip of the stone has pierced the skin of the fruit and is shown outward. The largest is the height of the 'Flat Queen' stone - 13.71 mm, followed by that of 'Mesembrine' - 13.64 mm. The values for the height of the stone in all studied cultivars are in close range and the differences are not statistically proven. Stone sizes range from 12.12 mm in 'UFO-4' to 20.11 mm in 'Flat Queen'.

Table 2. Average size [mm] and weight [g] of the stones – 2013-2016

CULTIVAR	Stone height [mm]	Stone width [mm]	Stone thickness [mm]	Stone weight [g]
ASF-2-80	12.86 a	18.55 a	21.25 a	2.70 a
FLAT QUEEN	13.71 a	20.11 a	22.17 a	3.35 a
MESEMBRINE	13.64 a	20.00 a	19.39 a	3.20 a
PLATIBELLE	12.68 a	18.39 a	19.25 a	2.57 a
UFO-4	12.12 a	18.25 a	19.18 a	2.44 a

The thickness of the stone is the largest of the three sizes for this group of cultivars and ranges from 19.18 mm for ‘UFO-4’ to 22.17 mm for ‘Flat Queen’. An exception is found only for the ‘Mesembrine’ cultivar, where the stone is slightly wider than thick. It can be asserted that the stones of this group of cultivars are small. Their weight ranges from 2.44 g in ‘UFO-4’ to 3.35 g in ‘Flat Queen’. There is no statistically proven difference between the values of the tested cultivars.

In the course of the research, it was found that the relative share of the stone from the total fruit weight (F/S - flesh/stone ratio) is small, but the values vary double from 2.26% in the case of ‘ASF-2-80’ to 4.91% in ‘Mesembrine’. The value of the last cultivar has a proven statistical difference from the values of all other cultivars. It can be assumed that peach cultivars with flat-shaped fruit have stones with a very small relative share. This means that in 1 kg of fruit there is a large consumable part.

Indexes, also called coefficients or ratios, provide additional but more specific information about the shape of the fruit. They are formed as the proportions of the three dimensions of the fruit by comparing each to each. It is known that as the values of the coefficients are closer to 1, the fruits are in a form closer to a globular. As these values are less than 1, the fruits have a flatter shape and vice versa – as the same is larger than 1, so the fruits are more elongated.

The results of the studies showed that the values of the height/width and height/thickness coefficients are much lower than 1 and are closer to 0.5, which means that the height of the fruits is almost half the width and the thickness (Table 3). This highlights the flat shape that can be understood even without visual contact with the fruit. Width/thickness coefficient values are very close to 1, indicating that the cross-section of the fruit is circular.

Table 3. Indices (coefficients) of fruits and relative ratio of the stones [%] – 2013-2016

CULTIVAR	Fruit height / Fruit width ratio	Fruit height / Fruit thickness ratio	Fruit width / Fruit thickness ratio	Stone to fruit weight ratio (F/S) [%]
ASF-2-80	0.52 c	0.51 d	0.98 a	2.26 b
FLAT QUEEN	0.59 b	0.59 b	1.00 a	2.46 b
MESEMBRINE	0.65 a	0.64 a	0.99 a	4.91 a
PLATIBELLE	0.58 b	0.56 c	0.96 a	3.01 b
UFO-4	0.52 c	0.51 d	0.98 a	2.72 b

The fruits of cultivar ‘UFO-4’ ripen first (about 15 days before the fruits of the standard ‘Redhaven’) and the latest ripening is the ‘Flat Queen’ (Table 4). All studied peach cultivars have white fruit flesh, a distinctly sweet taste and a strong specific flavour. An exception is the ‘Mesembrine’ nectarine cultivar, the fruit of

which has a sweet-sour taste. The covering skin colour varies from 60% to 90% of the fruit surface coverage, while for the ‘Mesembrine’ it occupies up to 100%.

Table 4. Basic pomological characteristics of the fruits

CULTIVAR	Ripening date [compared to Redhaven]	Fruit skin color		Fruit flesh color
		Ground color	Hue of over color	
ASF-2-80	+ 15 days	cream white	Red 60-70%	white
FLAT QUEEN	+ 20 days	cream white	Red 70-80%	white
MESEMBRINE	+ 5 days	cream yellow	dark red 100%	yellow
PLATIBELLE	+ 6 days	cream white	dark red 90%	white
UFO-4	- 15 days	greenish white	Red 80%	white

Conclusions

The peach cultivars with flat shape have smaller fruits than traditional cultivars but are attractive due to their specific appearance. The tendency is also maintained for the flat-shaped nectarines to have smaller fruits compared to peaches of the same group, as is the case with round-shaped peaches and nectarines. Flat-shape peach and nectarine’s stones have a specific transverse flat shape and demonstrate a small relative share of the total fruit weight.

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