

Growth rate patterns of introduced flat peach cultivars (*Prunus persica* (L.) Batsch f. *compressa*) in nursery

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Abstract

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The study was conducted in the period 2018 – 2019, in the nursery garden of Khan Krum Agricultural Research Centre, Shumen region. The experiment is based on the block method of control with four repetitions. The nursery is maintained under irrigated field conditions and the application of traditional agricultural techniques. The subject of the study are eight flat peach cultivars: Mesembrine, Poragnayo ricla, Sicilian local, Flat queen, Flat late peach, ASF – 2 – 80, Flat light, UFO 4, as well as some from the group of dessert peach cultivars – Red Haven (for standard). The studied varieties were cultivated on seed rootstock (Elbert) and clonal rootstock GF 677. The cultivation was performed in August, on a dormant bud, using the method of T-shaped cut of the stock. We analyzed the following indicators – autumn and spring budding percentage, growth rate patterns and thickening of the stem. The budding percentage in the autumn reporting varies from 81.7 to 96.2%, and the spring budding percentage is in the range of 78.2 – 94.1%. ASF-2-80 cultivar, showed the greatest growth rate. It was cultivated on GF 677, rootstock and it reached a height of 182.2 cm and a stem thickness of 18.1 mm.

Keywords: *Prunus persica* (L.) Batsch f. *compressa*; cultivars; rootstocks; cultivation, nursery

Introduction

Flat peaches (*Prunus persica* (L.) Batsch f. *compressa*), are a relatively new fruits in the range of fruits, available on the market in Bulgaria. The growing interest in this exotic species has caused a great demand for planting stock, which is offered by a small number of nursery in our country.

When selecting flat nectarines, special attention is paid to high productivity, improvement of sensory and taste qualities (Capocasa et al., 2012; Zhivondov, 2012). Studying the varietal diversity of flat peaches and nectarines, some scientists (Reig et al., 2012; Zhivondov et al., 2019), concluded that Mesembrine flat nectarine cultivar is characterized by a very good sensory profile and well-colored skin of the fruit flesh. According to Zhivondov et al. (2019), ASF – 2 – 80, Flat Queen, Mesembrine, Platibelle and UFO 4 flat peach

cultivars have relatively small fruits, compared to the peaches of the dessert peach cultivars group. All of the studied flat peach cultivars had white fruit flesh, with the exception of the Mesembrine nectarine cultivar, which had yellow fruit flesh. According to Romeu et al. (2015), the flat peaches UFO-3 and Sweet Cap are characterized as high yielding, with good growth rate and very good adaptability to the climatic conditions of Southeastern Spain.

In this regard, attempts have been made to find the optimal rootstock combination in flat peaches, which combines good growth, high productivity and adaptability to different soil and climatic conditions (Abrisqueta et al., 2017).

Legua et al. (2012), tested eight rootstocks that are suitable for growing flat peaches, namely GF 677, Krymsk 86, PADAC 97 – 36, PADAC 99 – 05, PADAC 9912 – 03, PADAC 0024 – 01, PADAC 0021 – 01, PADAC 0022 – 01, culti-

vated with the UFO 3 cultivar. According to the authors, the clonal rootstock GF 677 is characterized by a high growth rate and having the highest yield compared to the others. In this regard, Romeu et al. (2015), reported that GF 677 showed very good compatibility with UFO – 3 and Sweet Cap flat peach cultivars.

According to Hudina (2017), the clonal rootstock is suitable for growing fifteen flat peach and nectarine cultivars, such as: Plane Gem, Plane Top, Plane Sun, Plane Gold, Ornella Oriane, Platicarpa Bianka, Platibell, Platifun, and the yellow fruit flesh cultivar Platimoon, UFO 3, UFO 4, Platifirst, Early Sandwich. The highest yields were shown by UFO 4 and UFO 3.

According to Grigorov (1982), the Redhaven cultivar has been successfully adapted to the soil and climatic conditions of our country, and is widely used in the peach production.

Flat peaches are relatively new fruits for our country and the data published about them is quite scarce. In this regard the aim of the research is to study their growth strength and compatibility of certain cultivars with different rootstocks in the nursery.

Material and Methods

The study was conducted in the period 2018-2019, in the nursery of Khan Krum Agricultural Research Centre, Shumen district. The experiment is based on the block method with four repetitions. The nursery is maintained under irrigated field conditions and the application of standard technology. The cultivation was performed in mid-August 2017, on a dormant bud, using the method of T-shaped cut of the stock. The rootstocks were planted at distances of 100/15 cm. The subjects of the study are the following flat peach and nectarine cultivars: Mesembrine (Flat nectarine), Poragnayo rycla, Sicilian local, Flat queen, Flat late peach, ASF – 2 – 80, Flat light, UFO 4, as well as Red Haven from the group of desert peach cultivars (for standard). The studied varieties were cultivated on seed rootstock (Elbert) and clonal rootstock GF 677. We observed the following indicators: percentage of autumn and spring budding, growth rate patterns and stem thickening. The growth rate patterns and the stem thickening were measured every 10 days. Height is measured in cm. and the thickness of the stem in mm, by means of a micrometer. Data was statistically analyzed, according to Duncan's criterion (Lidanski, 1988).

Results and Discussion

The results, obtained by the autumn and spring budding are presented in Table 1.

Table 1. Interception of the buds average for period 2018 – 2019

Cultivar / rootstock	Autumn, %	Spring, %
Mesembrine / seminal	90.3 bc	85.4 e
Mesembrine/GF 677	86.5 cd	82.8 e
Flat light / seminal	94.5 ab	91.4 b
Flat light/GF 677	92.4 b	87.2 d
Flat late peach / seminal	96.2 a	93.4 a
Flat late peach/GF 677	93.5 b	89.2 c
Sicilian local/ семенна/seminal	95.2 ab	94.1 a
Sicilian local/GF 677	92.6 b	88.6 cd
UFO 4 / seminal	91.3 bc	86.2 de
UFO 4/ GF 677	88.3 c	84.7 e
ASF – 2 – 80 / seminal	87.3 cd	83.6 e
ASF – 2 – 80/ GF 677	86.8 cd	81.2 e
Poragnayo rycla / seminal	84.2 de	80.3 e
Poragnayo rycla/ GF 677	81.7 e	78.2 e
Flat queen / seminal	85.1 d	81.7 e
Flat queen/ GF 677	83.2 de	79.3 e
Red Haven / seminal	89.5 bc	86.8 de
Red Haven/ GF 677	86.2 cd	83.1 e
Standard		
LSD 5%	2.5	1.3

The percentage of set-off is an indicator, in which the subjective factor influences, and gives us an approximate estimate of the expected yield of fruit trees. The presented results are the evidence that in the autumn reporting rootstock combinations Flat light (seed rootstock), Sicilian local (seed rootstock) and Flat late peach /seed rootstock/ (94.5 – 96.2%), have proven high value characteristics. For the other cultivars of clonal rootstock GF 677 and seed rootstock (Elbert), the budding is in the range of 80% – 90%. Some cultivars, such as the nectarine Mesembrine, Flat Late, Flat late peach, Sicilian Local and UFO 4 on seed rootstock and clonal rootstock, show better autumn budding than the standard Red Haven. Relatively less budding was found in Flat queen and Poragnayo rycla (81.7 – 85.1%). We observed that the seed rootstock showed a relatively high percentage of buds, compared to the clonal rootstock GF 677. The data obtained can be explained by the genetic similarity of flat peaches with the Elbert seed rootstock.

The spring budding gives us a clearer idea of the expected yield of standard fruit trees. In this regard, Flat light, Late flat peach and Sicilian local, cultivated on seed rootstock (91.4 – 94.1%), are distinguished by relatively more budding. Most of the rootstock combinations show good results (80.3 – 89.2%), which gives us reason to expect the optimal number of fruit plants. Poragnayo rycla and Flat queen are characterized by less than 80% budding (78.2 – 79.3%), which is also a good result and in this case re-cultivation is not required. Compared

Table 2. Sizes of the obtained trees in the nursery second year (average for the period 2018 – 2019)

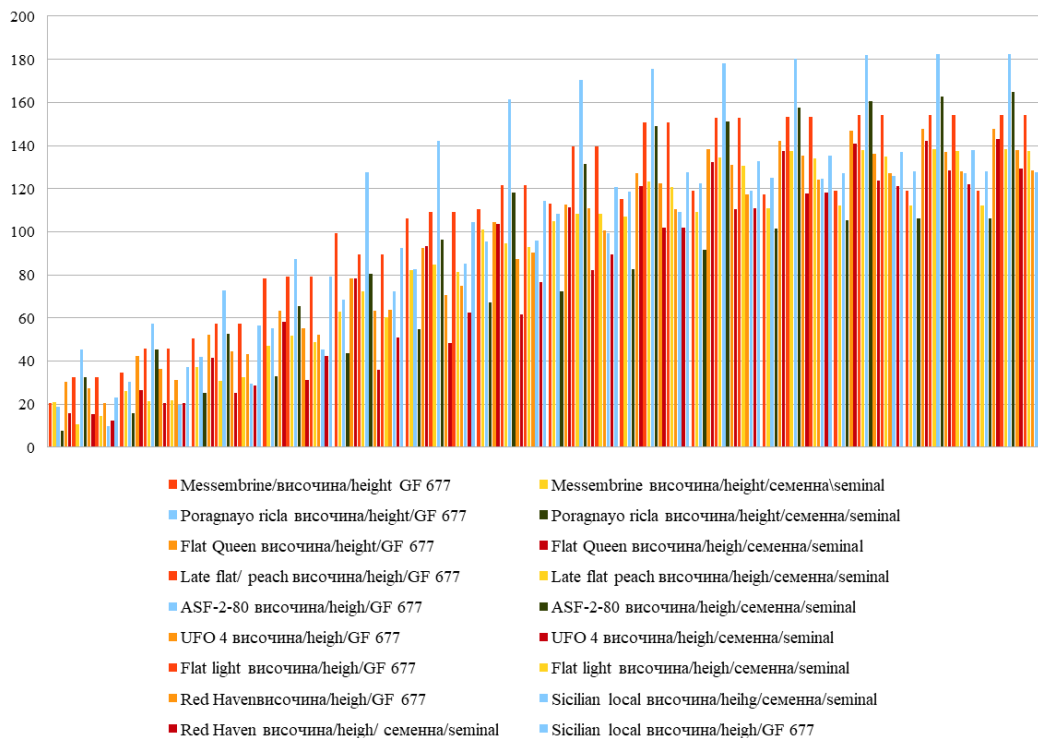
Cultivars	Rootstocks			
	seminal (Elbert)		INRA GF 677	
	height, cm	thickness, mm	height, cm	thickness, mm
Mesembrine	113.5 d	12.4 c	119.2 e	13.0 c
Flat light	117.6 d	12.6 c	128.0 e	13.3 bc
Flat late peach	137.6 b	13.9 bc	154.3 b	15.8 b
Sicilian local	127.5 c	12.9 c	138.4 d	13.4 bc
UFO 4	126.3 cd	12.5 c	137.9 d	14.2 bc
ASF – 2 – 80	165.4 a	16.9 a	182.2 a	18.1 a
Poragnayo ricla	119.2 d	12.3 c	127.8 e	14.3 bc
Flat queen	134.1 c	14.5 b	147.8 c	16.5 ab
Red Haven Standard	118.4 d	13.1 bc	128.3 e	14.1 bc
LSD 5%	6.7	1.3	3.0	2.1

to the standard (Red Haven), a significant number of cultivars have a higher budding rate. Comparing the data obtained from the two rootstocks, it can be seen that in the seed rootstock (Elbert), the percentage of budding is relatively higher than the clonal rootstock GF 677. The presented data it is evident that GF 677 shows very good compatibility with the studied cultivars, which is a prerequisite for obtaining higher quality production in the plantation.

The data on the growth rate patterns of the grafts cultivated on seed rootstock (Elbert) and clonal rootstock GF 677

are presented in Table 2.

The height of the plants in the cultivars on a seed rootstock (Elbert) varies in the range of 118.4 cm to 165.4 cm. ASF – 2 – 80 (165.4 cm) stands out with proven highest grafts in the group, followed by Flat queen and Flat late peach (134.1 – 137.6 cm). Most of the cultivars exceed the Red Haven standard, with the exception of Mesembrine and Flat Late (113.5 – 117.6 cm). All studied cultivars have a height of more than 100 cm, which determines the resulting planting stock as standard.

**Fig. 1. Dynamics of growth**

The results, obtained for the thickness of the plant stem vary from 12.3 to 16.9 mm. ASF – 2 – 80 cultivar, is superior to the other studied cultivars, followed by Flat late peach and Flat queen (13.9 – 14.5 mm). The listed cultivars exceed the standard cultivar, as all the others yield to it. The studied cultivars have a stem thickness of more than 10 mm, which is an important condition for the quality of the planting stock. In this regard, the resulting fruit trees are defined as standard.

From the presented data on plant height for the cultivars on rootstock GF 677, it is evident that they exceed in this indicator those with seed rootstock (Elbert). This can be explained by the stronger growth that the clonal rootstock gives to the grafts. In this regard, the height of the plants in the studied rootstock combinations varies in the range of 119.2 cm to 182.2 cm. Flat queen, Flat late peach and ASF – 2 – 80 (147.8 – 182.2 cm) are distinguished as the highest plants. Most of the cultivars exceed the standard for this indicator. The plants having lower height than Red Haven are the nectarine cultivar Mesembrine and Flat light cultivar (119.2 – 128.0 cm).

The thickness of the stem is an important indicator, characterizing the growth rate pattern of the fruit species and is related to the quality of the planting stock.

In this regard, the leading place in the analyzed indicator is occupied by the cultivars Late Flat Peach, Flat Queen and ASF – 2 – 80 (15.8 – 18.1 mm). Mesembrine, Flat light and Sicilian local (13.0 – 13.4 mm) were reported for having statistically proven lower values, compared to the standard cultivar.

The obtained results confirm the data from our previous studies on the growth rate pattern of the seed rootstock (Elbert) and GF 677 (Vassilev & Zhivondov, 2015).

Figure 1 shows the growth rate pattern and the thickening of the stem of the cultivars Mesembrine, Poragnayo ricla and Flat queen grafted on seed rootstock (Elbert) and clonal rootstock GF 677.

Stem thickening is an important biometric indicator that has to do with the quality of seedlings. Mesembrine nectarine cultivar is characterized by a faster rate of stem thickening (mm), when there is a GF 677 rootstock. This is evident in the fourth, fifth, sixth and seventh measurements. Then the difference decreases, but nevertheless, GF 677 exceeds the seed rootstock (Elbert) from the first to the last measurements.

In the case of Poragnayo ricla cultivar, the grafts cultivated on GF 677 have a faster initial start than those on a seed rootstock. In the period from 29.07. to 18.08., this difference increases and the fruit trees of GF 677 take a significant advantage over those of seed rootstock. At the end of the growing season, the tree, cultivated on GF 677, has a stem thick-

ness exceeding 14 mm, and the plants on the Elbert rootstock barely exceed 10 mm.

Flat queen first measurements show that the difference between the plants on the two rootstocks is small and it is in favor of the clonal one. From 19.07., the grafts on GF 677 show a stronger thickening of the stem and the difference increases, respectively.

It was observed, in the last two measurements, that the plants with the seed rootstock (Elbert) could catch up with the other cultivars, but this was not enough to reduce the difference.

The height of the plants is an important quantitative indicator, on which the quality of the cultivated planting stock depends. Characteristic of the flat nectarine Mesembrine is that at the beginning of the vegetation (30.05), the grafts on both rootstocks have equal start. After the second measurement, the plants on the clonal rootstock GF 677 show a strong growth rate. In the next five measurements, there is an increase in growth rate in favor of GF 677, after which catching up and reducing the difference occurred.

In Poragnayo ricla, the grafts, cultivated on the clonal rootstock, show an intensive increase in height, and this trend is maintained until the last measurement. In the analyzed rootstock combination, the superiority of GF 677 is the greatest one, compared to the ones considered so far.

It is characteristic of the Flat queen cultivar that from the first measurement (30.05), the clonal rootstock exceeds the seed rootstock. The relatively fast growth rate lasts until 19.06., then in the period from 9.07. to 29.07., the grafts of the two rootstocks are almost equal. The results, obtained in the following measurements, show that the fruit trees cultivated on GF 677, exceed the grafts on the seed rootstock. This trend is maintained until the last measurement.

The cultivars Flat late peach, ASF-2-80 and UFO 4 are characterized by a stronger growth rate, when they are grafted on GF 677, with the difference between the two rootstocks being the largest on 8.08. After this date, the plants of Flat late peach and UFO 4 catch up and reduce the difference. GF 677 grafts definitely have greater growth rate from the first to the last measurement. The same trend is observed for ASF – 2 – 80, but unlike the previous two cultivars, the difference in the last few measurements is greater.

The study also includes Red Haven, which is well known to fruit growers in our country. It also retains the superiority of the grafts on the GF 677 rootstock, but in the last few measurements, the difference between the two rootstocks is the smallest. This is due to the growth characteristics of the graft, which is characterized by moderate growth rate. The obtained results confirm the data observed by Grigorov (1982), who defines Red Haven as a moderately growing cultivar.

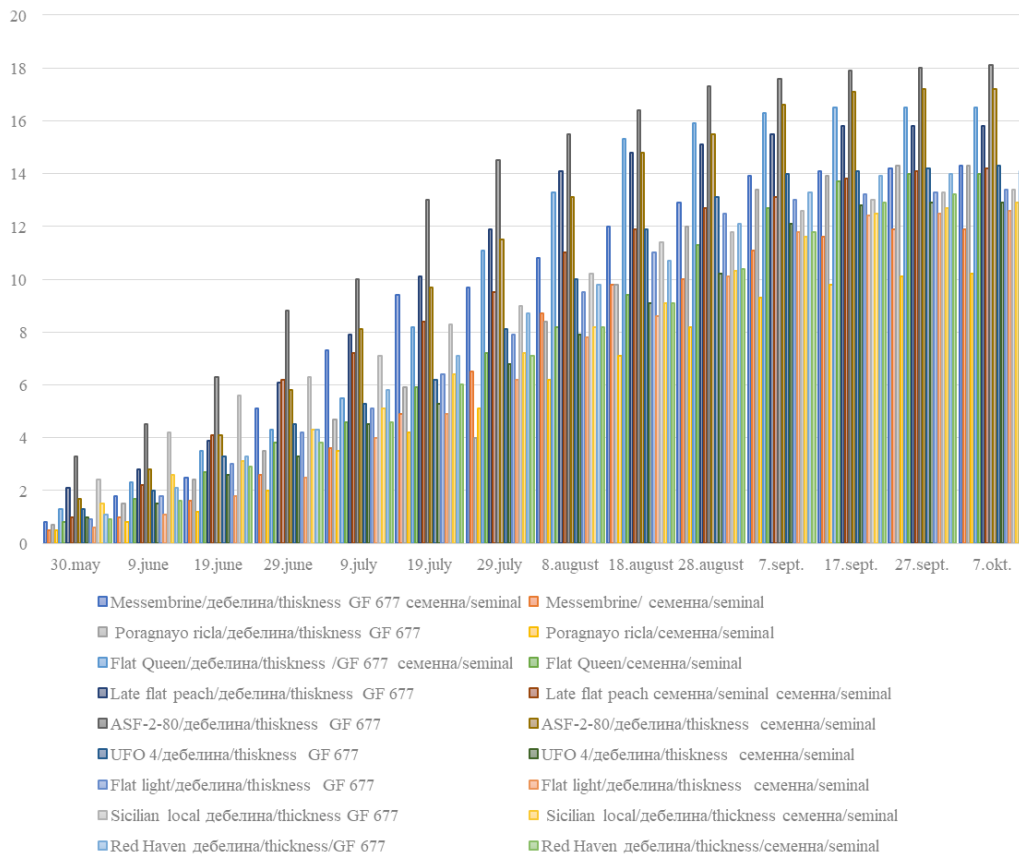


Fig. 2. Dynamics of thickening of the stem, mm

Characteristic of the thickening of the stem in the Flat late peach cultivar is that in the first two measurements the plants on GF 677 rootstock, show a better initial start and exceed those on the seed rootstock. In the next two measurements, catch-up occurs, after which the grafts on the clonal rootstock GF 677 are characterized by a faster rate of stem thickening (Figure 2).

More intensive stem thickening was observed in the plants on GF 677 rootstock for the cultivars ASF – 2 – 80, UFO 4 and Red Haven, happening from the first to the last measurements. In this regard, at the end of the growing season, the difference between the grafts cultivated on Elbert and GF 677 decreases significantly.

The height of the plants in Sicilian local and Flat light increases more intensively at the beginning and in the middle of the vegetation period, when they are cultivated on GF 677. The tendency of decreasing the difference between the two rootstock combinations remains in the last measurements.

Regarding the stem thickening, the grafts have a similar development for the grafts, cultivated on seed rootstock and

on clonal rootstock. The presented results show that with the Sicilian local last measurement the difference between the two rootstocks is very small in favor of the graft, cultivated on GF 677.

Conclusion

The seed rootstock (Elbert), is characterized by a relatively high percentage of budding, compared to the clonal rootstock GF 677. Flat light, Flat late peach and Sicilian local (91.4 – 94.1%), cultivated on seed rootstock are distinguished by more budding in spring. Most of the rootstock combinations show good results (80.3 – 89.2%), which gives us reason to expect the optimal number of fruit tree plants.

The compatibility of the studied cultivars with GF 677 and Elbert rootstocks is very good and re-cultivation is not required in the spring.

All cultivars have a height of over 100 cm, which determines the resulting planting stock as standard. The studied rootstock combinations have a stem thickness of more than

10 mm, which is very important for the quality of the planting stock. In this regard, the resulting fruit trees plants are considered standard.

Grafts on GF 677 are characterized by a better rate of growth and thickening of the stem, and the resulting fruit trees exceed those on seminal rootstock.

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