

Preservation and study of old local forms of the so called “vineyard peach” (*Prunus persica* L.) in the Shumen region, Bulgaria

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Abstract. During the period 2015-2017, scientific expeditions were conducted in the region of the town Shumen, located in the north-eastern part of Bulgaria, mainly around the village Madara where the concentration of natural forms derived from seedlings is the greatest. The purpose is to discover and research old local forms of the so called “vineyard peach” and to preserve them for possible future inclusion in breeding programmes to create new cultivars using more extended genepool. As a result, three forms of “vineyard peach” were selected from the local populations. The fruits of the three local forms are small and with primitive taste qualities but fit for human consumption. Two of the forms have white fruit flesh and one is with green. Two of the peach forms have vigorous growth, but one of the forms with white fruit flesh is of weak vigour. The three forms are spontaneous natural products obtained through long-term seed propagation. The trees are old but vital and without visual damage by diseases and pests, regularly bear fruits and have good annual growth despite competition from weeds, bushes and trees.

Keywords: peach, *Prunus persica* L., local forms, breeding programmes

Introduction

The fruit species and natural form diversity in Bulgaria is very large and represents an inexhaustible genetic source for the selection of valuable forms resistant to various biotic and abiotic stress factors. In the abandoned former agricultural territories, primitive forms of different fruit species can be found, breeding through a natural seed way, the most resistant of which survive and develop according to the principles of natural selection. Local forms of the so called “vineyard peach” have long been propagated in the past only by the means of seeds. They are grown mainly at the ends of the vineyards, from which they bear the name. As a result of long-term seed propagation, not only did they acquire primitive look but also some genetic homogenization of the populations originating in a region. In this sense, the seedling population of each locality is a degraded collection of seed-derived specimens with very similar phenotypic characteristics. It can be argued that each individual “vineyard peach” population is very close to a pure line. This is defined not only by the phenotypic similarity and uniformity in the population, but also by the smaller pomological differences between specimens in the next generations. As partially pure lines, the local forms of “vineyard peaches” are interesting biological products, of which, when used in breeding, heterozygous effects can be expected.

In the breeding programs for creating new cultivars, often the same parental forms and cultivars with proven qualities are used, but this leads to a limitation of the used genepool (Darrow, 1966; Sjulín and Dale, 1987; Ma et al., 2003). In general, many of the main fruit cultivars have occurred from a common progenitor. Lack of genetic diversity can lead to the sensitivity to different diseases and pests, as well as the emergence of new sustainable races and pressure on the environment (Scott and Lawrence, 1975).

The successful development of new combinations of characteristics in the future cultivars may be limited by the lack of a broad genetic base, and this could require the use of exotic sources and gene modifications. Until the development of molecular identification techniques, it was not clear exactly how much genetic diversity is available in the breeding programs. The pedigree information of the cultivars does not give a precise indication, as some of the original progenitor branches, although having different names, may actually be the same or genetically very similar (Graham et al., 1996). In more recent search, microsatellites or simple sequences repeats (SSRs) were used for cultivar identification in peach and cherry, and for synteny analysis in *Prunus* (Dirlewanger et al., 2002). The availability of the peach genome sequence has enabled relevant research in peach and identification of genes underlying important horticultural traits (International Peach Genome Initiative, 2013; Verde et al., 2017) crucial to the success of the breeding programmes.

Bulgaria is a country with a very rich species composition and a wide variety of wild relatives of the cultural plants. It ranks sixth in the world by biodiversity (Maxted et al., 2012). Wild and cultivated representatives, as well as forms from the genus *Prunus*, at various stages have been included in several interspecific hybridisations in breeding programmes in Bulgaria as donors of various resistances (Zhivonov, 2012). In other fruit crops, part of the local varieties in the country have been identified as immune and others as practically resistant to some economically important diseases (Marinova and Ivanova, 2015).

With the onset of climate change, some of the established and widely distributed peach cultivars showed partial inability to develop their biological potential. An important necessity in this connection is the search for and inclusion in the breeding process of natural degraded forms, surviving and yielding suc-

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cessfully under natural conditions. The purpose of the present study is to preserve and evaluate three selected local forms of the so called “vineyard peach”, and to consider the possibility for inclusion in breeding programme for the creation of new peach cultivars resistant to biotic and abiotic stress factors.

Material and methods

In the period 2015-2017, a series of scientific expeditions took place around the region of the town of Shumen and the villages of Madara and Khan Krum from the same area. Three populations of “vineyard peach” were found in local fields and private vineyards. Three peach forms are selected and described, one specimen from each population aged over 20 years, obtained naturally by seeds.

According to the methods adopted at the Fruit Growing Institute – Plovdiv (Nedev et al., 1979; UPOV TG/53/7, 2014), the biometric parameters of the canopy were examined: trunk section and the structure of the different types of shoots - vigorous fruiting shoots, brindles, mixed shoots, spurs, feather shoots. Quantitative indicators such as yield, fruit weight (F), stone weight (S), as well as the ratio between them (F/S ratio), have been established. The productivity factor and the yield per cubic meter of the canopy (specific yield) were determined.

A brief pomological description of each of the three selected forms of “vineyard peach” was made.

Biometric data were processed statistically by using the method developed by David B. Duncan (Duncan, 1955; Harter, 1960). The software used in the study is “R-3.1.3” in combination with “RStudio-0.98” and installed package “Agricolae 1.2-2” (Mendiburu, 2015).

Results and discussion

As a result of the conducted scientific expeditions in the region of the town of Shumen, located in the north-eastern part of Bulgaria, three local forms of “vineyard peach” were studied.

Form 1: As a result of the expeditionary studies around the village of Madara, ‘Form 1’ was selected. The tree is distinguished by moderate growth and open (spreading) growth habit. Flower buds are small. The cross-section of the trunk has an area of 63.0cm², and the canopy volume is 2.3m³. The canopy is well-garnished with one-year-old shoots and the feather shoots occupy a major share - 45.1% (Table 1). Mixed shoots are significant for peach, accounting for 30.1%, nearly one-third of the annual growth. The smallest share of 0.9% is of the vigorous fruiting shoots. Leaf glands (nectaries) are kidney-shaped, which as a pomological attribute correlates with good resistance to powdery mildew disease on peach. The flowers are relatively small, pink, with white petals.

Table 1. Growth characteristics of old local forms of “vineyard peach” (*Prunus persica* L.) (2015-2017)

Location	TCSA* (cm ²)	Canopy volume (m ³)	Structure of the canopy (%)				
			Vigorous fruiting shoots	Brindles	Mixed shoots	Spurs	Feather shoots
Form 1 (Madara village)	63.0 ^c	2.3 ^{ab}	0.9 ^b	12.7 ^c	30.1 ^a	11.2 ^a	45.1 ^a
Form 2 (Khan Krum village)	66.0 ^a	2.9 ^b	2.8 ^a	16.1 ^a	26.7 ^c	11.2 ^a	43.2 ^a
Form 3 (Town of Shumen)	65.2 ^b	3.3 ^a	1.3 ^{ab}	15.3 ^b	27.7 ^b	10.6 ^b	45.1 ^a

* TCSA - Trunk cross-sectional area

The fruits ripen gradually in the second half of August. They are small to medium large, with an average mass of 103.6g (Table 2). Their shape is circular (round, globose), with a strongly pointed fruit pistil end. The prominence of suture is well-defined, and the two halves are almost symmetrical. The depth of stalk cavity is narrow and moderately deep. Fruit skin is medium thick, light green, with small fine pubes-

cence, without an over colour. Fruit is fit for consumption. It is tender, juicy and sweet, with low acidity and tartness, with a distinct aroma. The stone is small, with an average weight of 4.9g and a relative share of 5.2% of the total fruit weight (Fruit / Stone weight ratio). It is circular, light coloured, with narrow pits and sharp point. The degree of stone adherence to the flesh is medium.

Table 2. Fruit and stone biometry of old local forms of “vineyard peach” (*Prunus persica* L.) (2015-2017)

Location	Average fruit mass (g)	Weight of the stone (g)	Fruit / Stone weight ratio (%)
Form 1 (Madara village)	103.6 ^{ab}	4.9 ^b	4.7 ^b
Form 2 (Khan Krum village)	106.8 ^a	5.6 ^a	5.2 ^a
Form 3 (Town of Shumen)	92.8 ^b	4.7 ^b	5.1 ^a

Form 2: From the studies conducted in the natural population near the village of Khan Krum, 'Form 2' was discovered in a natural local population of "vineyard" peaches. The tree is characterized by moderate growth and spreading growth habit. The cross-section of the trunk has an area of 66.0cm², and canopy volume of 2.9m³. The canopy is well garnished with one-year-old shoots, in whose structure predominate the feather shoots - 43.2%. Mixed shoots occupy a sufficiently high share - 26.7% and the smallest share is that of the vigorous fruiting shoots - 2.8%. Brindles and spurs account for 16.1% and 11.2% of the total (Table 1). The leaf glands are kidney-shaped. The flowers are self-fertile, rosette type, relatively small, with white petals.

The fruits ripen in mid-August, with ripening taking place from 10 to 20 August. They are small to medium sized, with an average weight of 106.8g (Table 2). Their shape is circular, with a pointed fruit pistil end, with strong prominence of suture, and almost symmetrical halves. The stalk cavity is narrow, moderately deep. Fruit skin is light green, medium thick, covered with fine pubescence. It is separable from the fruit flesh. The flesh has a bright green hue, tender, medium juicy, with a satisfying sweet-sour taste and well-defined aroma. The flesh is semi-separable from the endocarp (stone, pit). The stone is medium sized, with a mass of 5.6g, accounting for 5.2% of the total fruit weight. It is light coloured, with slightly bulging sides and a very sharp point.

Form 3: From surveys conducted in a local population near the town of Shumen 'Form 3' is selected. The peach tree has a weak to moderate growth and a round canopy, well garnished with one-year-old shoots. The cross-section of the trunk has an area of 65.2cm², and the canopy volume is 3.3m³. In the structure of the one-year-old shoots, the share of the feather shoots is 45.1%, followed by the mixed shoots - 27.7%. With the smallest relative share being the vigorous fruiting shoots - 1.3%, the brindles and the spurs occupy 15.3% and 10.6%, respectively (Table 1). The leaf glands are kidney-shaped. Flower buds are small. The flowers are self-fertile, small, rosette type, with white petals.

The fruits (Figure 1) ripen extensively from 25 August to 10 September. They are small to medium, with an average weight of 92.8g (Table 2), with a circular shape and a strongly pointed fruit pistil end. The prominence of suture is well-defined and divides the fruit into two almost symmetrical halves. The fruit skin is light white to green, with no over colour, medium thick, tightly covered with short pubescence. The flesh is medium

tender, medium juicy, cream white, with a sweet-sour taste and pleasant aroma. The stone is small - 4.7g, with a relative F/S ratio of 5.1%, light brown, with a sharp point, slightly bulging, with narrow grooves, semi-separable from the fruit. No visual symptoms of bacterial spots disease and powdery mildew on peach have been observed on Form 3. In more humid years it is attacked by brown rot.



Figure 1. Local form from the town of Shumen - 'Form 3'

It is evident from Table 1 that the highest canopy volume is of Form 3, and the smallest – of Form 1. The largest trunk cross-sectional area is in Form 2, and the smallest in Form 1, with the results being statistically proven. In the three examined peach forms, the relative share of the feather shoots is the largest, and the lowest is that of the vigorous fruiting shoots. Mixed shoots, the most important in the peach, occupy second position in the structure of the fruiting tree. Fruits of Form 2 are the largest, and the smallest ones are of Form 3. The yield (Table 3) is the highest in Form 2 - 106.8 kg/tree, and the lowest in Form 3 - 92.8 kg/tree. Productivity coefficient expressed in kg/cm² of trunk cross-sectional area (TCSA) is the highest in Form 1 – 0.92kg/cm² and the lowest in Form 3 – 0.7 kg/cm². The specific yield (yield per cubic meter of the canopy) is the highest in Form 1 – 25.2kg/m³, and the lowest in Form 3 – 13.9kg/m³.

Table 3. Reproductive performances of old local forms of "vineyard peach" (*Prunus persica* L.) (2015-2017)

Location	Yield per tree (kg)	Factor of productivity (g/cm ²)	Yield per canopy volume (kg/m ³)
Form 1 (Madara village)	57.9 ^a	0.92 ^a	25.2 ^a
Form 2 (Khan Krum village)	50.5 ^b	0.76 ^b	17.4 ^{ab}
Form 3 (Town of Shumen)	46.0 ^c	0.70 ^c	13.9 ^b

The original trees of the three selected forms have been marked at the place of discovery and new trees have been planted in private orchards in order to preserve them. Further observations and study in collection orchards and nursery are necessary to evaluate their resistance/susceptibility to biotic (diseases and pests) and abiotic (drought and frost) stressors. Their suitability for rootstocks is yet to be established in nursery.

Conclusion

Emerging climate change necessitates the search for new selection sources, donors of different types of resistance, both to abiotic and biotic stressors. The three discovered local forms of the so called “vineyard peach” (*Prunus persica* L.) thrive successfully under difficult conditions without agro-technical care. They regularly bear fruits and have good annual growth despite competition from weeds, bushes and trees. There have been no visual symptoms of economically important diseases such as peach powdery mildew, peach leaf curl and bacterial spot, but further evaluation is required before including them in breeding programmes for the creation of new peach cultivars and rootstocks using more extended gene pool. The three forms have been preserved in private orchards and the original trees have been marked.

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