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GENETIC GAIN FROM SELECTION OF VINEYARD PEACH NATIVE POPULATION

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Vineyard peach native population in our country represents important and rich source of genetic variability. Establishment of the genetic gain and differences concerning genetic variability are very important in selection of the genotypes with different usability. In according to the start up population and after selection of 25% intensity important properties such as fruit quality indexes were examined. Those were fruit weight, output, appearance, taste, aroma, soluble solid and total sugar content and titratable acidity. Besides variability components, coefficient of variation and heritability coefficient, expected and realized genetic gain was determined as well. In the start up population the lowest variability was established for output (CV=1.3%) and the highest for titratable acidity

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(CV=28.4%). For all analyzed characteristics, medium up to high values for heritability coefficient were determined in both start up population and selected genotypes. As a result of the selection in all properties came to genetic variance decreasing except in fruit appearance. Realized genetic gain was on the level or little lower that expected one for the majority of the properties.

Key words: genetic gain, heritability, variability components, vineyard peach.

INTRODUCTION

Vineyard peach [*Prunus persica* (L.) Batsch] is indigenous peach population that is cultivated or grown spontaneously in Serbia. The Balkan Peninsula can be considered as a secondary centre of genetic diversity in peach because of the large variability, resulting from different ecological conditions and human activities. On the other hand, vineyard peach is propagated exclusively by seeds, which has generated a rich source of genetic variability, also. As cited by NIKOLIĆ *et al*. (2010) within the vineyard peach native population, it is possible to find genotypes with valuable morphological traits that can be immediately distributed to the farmers or employed in breeding programs.

Study of vineyard peach germplasm is very intensive in Serbia. As a result of former studies numerous types have been recommended for rootstocks production, fresh consumption, and processing (PAPIĆ *et al*. 1997; NIKOLIĆ *et al*. 2005; RAKONJAC *et al*. 2008). However, besides the fact of such intensive work, there is a lack of registered vineyard peaches for various purposes. All of this indicates that investigation and collecting of vineyard peach types represents one of the most important targets for germplasm preserving.

Progress in breeding programs depends on the knowledge of traits, genetic systems controlling their inheritance, and genetic and environmental factors that influence their expression. To plan an efficient development program, it is necessary to have an understanding of the breeding systems coupled with statistical analysis (CHANDRABABU and SHARMA 1999). The assessment of genetic variability is the key to progress in fruit improvement. Information on levels of variability can be very useful for determining on which material to begin genetic improvement through breeding programs. Also to develop breeding strategies and maximize genetic gain, breeders need reliable information such as components of variation, heritability and coefficient of variation.

The aim of this study was to determine both genetic gain and changes in regard to genetic variability together with the selection of vineyard peach genotypes intended for fresh consumption.

MATERIAL AND METHODS

By gathering heterogeneous vineyard peach types all around Serbia, collection orchard was planted at the Experimental Station ‘‘Radmilovac’’ of the Faculty of Agriculture in Belgrade. The collection was planted in 1993. Planting

distance was 4 x 4 m. The trees were trained as open vase, under non-irrigated standard cultural practices. From the collection 20 genotypes intended for table consumption were identified as start up population. After long standing investigations five genotypes were qualified as promising. Exactly those 20 genotypes were marked as start up population and selected five genotypes were used as a material in this study.

In the period since 2006 by 2008 year the genotypes defined by the most important characteristic indicated fruit quality. Those were fruit weight, output, taste, aroma, soluble solid content, total sugar and titratable acidity. Within sample of 30 fruits gathered in full maturity, fruit weight (in g) was measured. Output, that represents mesocarp share in total fruit weight, was determined by calculating and given in %. Fruit appearance, taste and aroma were determined based on a points ranking from 1 (extremely poor) to 10 (extremely good) by a panel of 5 experts. Soluble solids content was determined by refractometer in °Brix. Total sugar content determined by Luff-Schoorl method in %. Titratable acidity was measured by neutralization to pH 7.0 with 0.1 N NaOH, data are given as g/l of malic acid.

For all examined properties, in start up population and in selected genotypes mean, components of variability (S^2_g and S^2_f), coefficients of phenotypic variability (CV_f) and coefficients of heritability in the broad sense (h^2) were determined. Furthermore, after selection which has been performed with an intensity of 25% (K = 1.28) realized (ΔG_r) and expected genetic gain (ΔG_e) was calculated. The genetic gain obtained for each trait was expressed as percentage of the mean of the trait for the start up population.

RESULTS AND DISCUSSION

Traits representing quality components approve to be the most important in selection of genotypes for table consumption. Peach fruit quality is conditioned by a great number of factors like fruit size, soluble solids, sugars and acids contents and sensory evaluation (ESTI *et al*. 1997; INFANTE *et al.* 2008)

The start up population of vineyard peach (Tables 1, 2 and 3) exhibits considerable phenotypic variation for fruit traits such as fruit weight (CV=19.7%) organoleptic evaluation (CV=13.6-14.5%) and chemical fruit components (CV=9.3-28.4%). It is very likely that this phenotypic variation has an important genetic component, and reflects variable farmer preferences. Output, by contrast, shows little variation (CV=1.3%). If it is known that output is derived trait, and that fruit and stone weight are highly positive correlated (QUARTA *et al*. 1999; RAKONJAC 2005) and assumed to be under the influence of pleiotropic genes, it is absolutely expected that this trait shows little variation in the population.

For the majority of properties variation degree that was noticed in start up population kept on in the selected genotypes which were indicated by the similar values of variation coefficients. Only for fruit appearance major decreasing of variability was determined after the selection, where CV in start up population was 14.5% and in the selected genotypes 6.9%.

Table 1. Variability, heritability and genetic gain for fruit weight and output in vineyard peach

Parameters	Start up population		Selected genotypes	
	Fruit weight	Output	Fruit weight	Output
Average	69.8	91.7	80.6	93.2
S^2g	155.84	1.03	170.90	0.62
S^2f	188.25	1.38	190.44	0.89
CVf (%)	19.7	1.3	17.1	1.0
h^2(%)	82.7	74.5	89.7	69.5
ΔG_r(%)	-	-	15.5	1.2
ΔG_e(%)	-	-	6.5	1.2

Values of heritability coefficients for fruit weight (Tab. 1) were high both in start up population (h^2=82.7%) and in selected genotypes (h^2=89.7%). Much lower values of heritability coefficient for peach fruit size were obtained by de SOUZA *et al*. (1998). High values of heritability coefficients for fruit weight were determined by RAKONJAC (2005) in peach cultivars and by MRATINIĆ *et al.* (2007) in apricot cultivars. These differences are not unexpected if we know that heritability coefficient value is a function of variability of a specific character in the studied population as well as a function of ecological conditions that the trees are grown in. The heritability coefficient value depends also on the experiment design as well as on the applied statistical procedure for its estimation.

Table 2. Variability, heritability and genetic gain for fruit appearance, taste and aroma in vineyard peach

Parameters	Start up population			Selected genotypes		
	Appearance	Taste	Aroma	Appearance	Taste	Aroma
Average	7.6	7.4	7.4	8.6	8.2	8.4
S^2g	0.73	0.55	0.66	-	0.97	0.70
S^2f	1.20	1.02	1.04	0.36	1.42	1.02
CVf (%)	14.5	13.6	13.7	6.9	14.5	12.0
h^2(%)	60.7	54.7	63.5	0[a]	68.0	68.5
ΔG_r(%)	-	-	-	13.2	10.8	13.5
ΔG_e(%)	-	-	-	11.2	9.5	10.8

[a]Negative values were assumed to be zero.

In tables 2 and 3, high values of heritability coefficients was determined only for soluble solids in both start up population and selected genotypes (h^2=81.9%; h^2=83.4%, respectively), while other traits had medium values of heritability coefficients (h^2=54.7-74.8%). Medium values of heritability coefficients for those properties were also obtained by RAKONJAC (2006) in peach.

Table 3. Variability, heritability and genetic gain for soluble solids, total sugar content and titratable acidity in vineyard peach.

Parameters	Start up population			Selected genotypes		
	Soluble solid	Total sugar	Titratable acidity	Soluble solid	Total sugar	Titratable acidity
Average	15.8	9.16	6.2	15.3	8.80	6.8
S^2g	1.78	0.71	0.21	2.38	0.78	0.39
S^2f	2.18	1.07	0.32	2.85	1.41	0.53
CVf (%)	9.3	11.0	28.4	11.0	13.5	33.7
h^2(%)	81.9	69.9	65.4	83.4	55.6	74.8
ΔG_r(%)	-	-	-	-3.2	-3.9	12.9
ΔG_e(%)	-	-	-	9.7	9.9	24.2

Realized genetic gains ranged from 1.2% for output to 15.5% for fruit weight. In contrast, for soluble solids and total sugar content a negative value of genetic gain were established. This suggests that values for these two traits were not increased rather hurt decreased by selection. The results are not reflected on the organoleptic evaluation of fruits after selection because the taste and aroma are complex characteristics and depend not only on chemical compound but also on the interaction between individual components.

For the output realized genetic gain was equal to the expected genetic gain. Slightly larger realized than the expected genetic gain was obtained for the appearance, taste and aroma. The most genetic gain was for fruit weight (ΔG_r=15.5%) and it is more than twice as higher as expected (ΔG_e=6.5%). In contrast, the realized genetic gain for the titratable acidity (ΔG_r=12.9%) was twice less than expected (ΔG_e=24.2%).

THAIPONG and BOONPRAKOB (2005) suggested that if genetic variance in studied traits is high, than genetic gain through breeding and selection is feasible. CORNELIUS *et al*. (2006) cited that, regarding autochthonus cultivars, selection intensity should be moderate in order to separate and collect genotypes with favorable traits and to keep genetic variability present in population that was accomplished with this study.

CONCLUSION

For all analyzed characteristics, medium up to high values for heritability coefficient were determined in both start up population and selected genotypes.

As a result of the selection in all properties came to genetic variance decreasing except in fruit appearance.

Realized genetic gain was on the level or little lower than expected one for the majority of the properties.

Level of genetic variability in the start-up population and genetic gains made as a result of selection suggest that natural vineyard populations is an important gene pool that can be applied in commercial production or breeding programs.

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GENETIČKA DOBIT PRI SELEKCIJI VINOGRADSKE BRESKVE IZ PRIRODNE POPULACIJE

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I z v o d

Prirodna populacija vinogradske breskve u našoj zemlji predstavlja značajan i bogat izvor genetičke varijabilnosti. Pri selekciji genotipova različite upotrebne vrednosti posebno je značajno da se utvrdi genetička dobit s jedne strane i promene u pogledu genetičke varijabilnosti s druge strane. U tom smislu u početnoj populaciji kao i nakon selekcije sa intenzitetom od 25% praćene su važnije osobine pokazatelji kvaliteta ploda. To su masa ploda, randman, izgled, ukus, aroma, sadržaj rastvorljivih suvih materija, ukupnih šećera i kiselina. Pored komponenti varijabilnosti, koeficijenata varijacije i heritablnosti utvrđena je i očekivana i ostvarena genetička dobit. U početnoj populaciji najmanje variranje ustanovljeno je za randman (CV=1,3%), a najveće za sadržaj ukupnih kiselina (CV=28,4%). Za sve analizirane osobine utvrđene su srednje do visoke vrednosti koeficijenata heritabilnosti i u početnoj populaciji i kod selekcionisanih genotipova. Kao rezultat selekcije kod svih osobina, osim izgleda ploda, nije došlo do smanjenja genetičke varijanse. Ostvarena genetička dobit je na nivou ili nešto manja od očekivane za većinu osobina.

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