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# VARIABILITY COMPONENTS AND HERITABILITY OF POMOLOGICAL AND CHEMICAL CHARACTERISTICS IN SOUR CHERRY CLONES OF CULTIVAR MONTMORENCY

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In 12 sour cherry clones of cultivar Montmorency 5 pomological (fruit length, fruit width, fruit weight, stone weight and fruit stem length) and 4 chemical characteristics (soluble solid content, total acid content, invert sugar content and total sugar content) were investigated. Based on results of analysis of variance for all examined characteristics, variability components, coefficients of genetic and phenotypic variation and coefficient of heritability in a broader sense were calculated. Considering components of total variability, year represented the component that caused variability of majority examined characteristics in the highest percentage. Coefficients of genetic variation showed that in investigated clones total acid content varied the least ($CV_g$ = 1.79%), and the most fruit weight ($CV_g$ = 11.41%). The lowest phenotypic varying was determined

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for fruit length ($CV_f$ = 4.01%) but the highest for fruit weight ($CV_f$ = 13.86%). Coefficient of heritability was the highest for stone weight ($h^2$ = 70.27%), and the lowest for total acid content ($h^2$ = 7.73%).

*Key words*: clonal selection, heritability, Montmorency, sour cherry, variability

## INTRODUCTION

Sour cherry is highly profitable fruit variety. Owing to its rapid coming into bearing, relatively easy growing and good demand on market, there is a huge interest for spreading this fruit variety, so in Serbian fruit production is on the third place (NIKOLIĆ, 2001). Fruit size and fruit quality have to be well investigated in order to estimate commercial potential of some new sour cherry cultivar or to accelerate selection in some breeding programme (IEZZONI, 1986). While the majority of sour cherry fruits are processed in our country, it is very important to investigate fruit size, fruit weight, stone weight, and chemical characteristics as well.

Advancement of sour cherry production, in the first place, depends on cultivar's biologic value, and after that on environmental ecological conditions and production methods (STANČEVIĆ and NIKOLIĆ, 1987). That is why clonal selection is important method in selection and investigation of new genotypes. The aim of the commercial sour cherry cultivars clonal selection is to keep all positive characteristics of certain cultivar with possibility to improve some other properties. New, selected genotypes have to fulfill even more producer's and consumer's demand considering blooming and ripening time, fruit quality, ability for mechanical harvesting, and resistance to climatic stress, diseases and pests (BRÓZIK, 1996). BIRD (1982) cited that in old American cultivar Montmorensy, that has unstable genotype, a numerous clones were selected.

While phenotypic value of certain property is sum between genetic influence and environment effect, it is important to know which part of phenotypic value is determined like genetic basis and witch by external environment conditions. Reliable estimation of genetic variance and its components is important for determination of characteristics heritability and estimation of genetic improvement obtained by applied selection method.

In selection work, HANSCHE *et al.* (1967) considered that heritability can help for following and confirmation of main changes in genetic variability. By calculating coefficients of heritability, genetic structure of progenies obtained by crossing of parental partners that were chosen based on certain characteristics, can be predicted. If one characteristic has higher coefficients of heritability, it can be easily and much faster improve than characteristic with lower coefficients of heritability (NYQUIST, 1991).

Considering all those facts, aim of this work was to establish components of variability, coefficients of genetic and phenotypic variation, and coefficients of

heritability in broader sense, for pomologic and chemical characteristics in sour cherry clones of cultivar Montmorency.

## MATERIALS AND METHODS

All investigations, in this study, were carried out in PKB "Voćarske plantaže" in commercial sour cherry orchard of cultivar Montmorency, that is situated in Begaljica. Orchard was planted in 1986, on a planting distance 4.5 x 3.5 m. During investigations, all necessary agro-technical measurements were done in the orchard.

Twelve sour cherry clones of cultivar Montmorency that were selected by primary selection from orchard were used as material in this study. In selected clones 5 pomological (fruit length, fruit width, fruit weight, stone weight and fruit stem length) and 4 chemical characteristics (soluble solid content, total acid content, invert sugar content and total sugar content) were investigated.

A 30 fruit sub-sample was used to measure fruit length, fruit width, fruit weight, stone weight and fruit stem length during full maturity time. Soluble solids content was determined using refractometer. Total acids content was established by titration with 0,1N NaOH, while Bertrand method was used to determine invert and total sugars content.

Components of variability for pomologic characteristics were determined based on two factorial analysis of variance, and chemical properties based on monofactorial analysis of variance (JOVANOVIĆ *et al*., 1992). Coefficients of genetic and phenotypic variation ( $CV_g$ and $CV_f$ ), as relative indicator of variability were determined according to SINGH and CHOUDHARY (1976). Coefficient of heritability in broader sense ( $h^2$ ) was calculated according to BOROJEVIĆ (1992) as a ratio between genetic and phenotypic variance. All values of components of variability, coefficients of variation and coefficients of heritability were expressed in percentage.

## RESULTS AND DISCUSSION

Data in Table 1 are showing that the highest fruit length was 1.71 cm (clone 13), and the lowest 1.51 cm (clone 4). The widest fruits were in clone 14 (2.02 cm), and besides that it had the highest fruit weight (4.62 g) and the highest stone weight (0.243 g). The lowest fruit width had clone 9 (1.70 cm) that also had the lowest fruit weight (2.83 g). The lowest stone weight (0.162 g) was determined in clone 11. Fruit stem length varied from 0.99 cm (clone 4) up to 2.73 cm (clone 13).

The highest soluble solid content (Table 1.) had clone 11 (15.54%), and the lowest clone 12 (13.35%). Total acid content was the highest in clone 3, and was 1.36% and the lowest in clone 12 (1.10%). The lowest invert sugar content was 8.66% (clone 14), while the lowest total sugar content was in clone 12 (9.91%). The highest invert sugar content and total sugar content showed clone 11 (10.97%; 12.13%).

*Table 1. - Mean values of pomologic and chemical characteristics of cultivar Montmorency clones*

| Clone | Fruit length (cm) | Fruit width (cm) | Fruit weight (g) | Stone weight (g) | Fruit stem length (cm) | Soluble solid content (%) | Total acid content (%) | Invert sugar content (%) | Total sugar content (%) |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 1.58 | 1.91 | 3.69 | 0.172 | 2.14 | 14.87 | 1.36 | 10.27 | 11.35 |
| 4 | 1.51 | 1.83 | 3.48 | 0.184 | 0.99 | 14.60 | 1.21 | 10.52 | 11.31 |
| 5 | 1.54 | 1.89 | 3.62 | 0.171 | 2.13 | 14.34 | 1.31 | 9.43 | 10.88 |
| 6 | 1.60 | 1.93 | 3.78 | 0.190 | 2.61 | 14.10 | 1.34 | 9.33 | 10.63 |
| 7 | 1.64 | 1.89 | 3.78 | 0.212 | 2.48 | 14.04 | 1.31 | 9.72 | 10.79 |
| 8 | 1.61 | 1.95 | 4.02 | 0.184 | 2.36 | 14.70 | 1.28 | 10.11 | 11.11 |
| 9 | 1.52 | 1.70 | 2.83 | 0.174 | 2.22 | 13.94 | 1.17 | 9.45 | 10.81 |
| 10 | 1.50 | 1.71 | 3.17 | 0.183 | 2.17 | 13.60 | 1.19 | 9.06 | 10.06 |
| 11 | 1.56 | 1.77 | 3.17 | 0.162 | 2.23 | 15.54 | 1.26 | 10.97 | 12.13 |
| 12 | 1.52 | 1.75 | 3.18 | 0.201 | 2.35 | 13.35 | 1.10 | 8.79 | 9.91 |
| 13 | 1.71 | 1.74 | 3.11 | 0.190 | 2.73 | 13.98 | 1.20 | 9.23 | 10.29 |
| 14 | 1.57 | 2.02 | 4.62 | 0.243 | 2.29 | 13.42 | 1.18 | 8.66 | 9.98 |

From Figure 1 can be seen that on total variability of fruit length, fruit width and fruit weight, years of investigations had the highest influence (67%; 79%; 84%, respectively), which is not in accordance with IEZZONI (1986), who examined components of variability for fruit length and fruit width in 17 sour cherry cultivars and determined that differences between cultivars took the biggest part in total variability of those characteristics. Experimental error and accidental factors participated with the lowest percentage in total variability of mentioned properties (1-5%). Variability of stone weight was influenced the most by differences between genotypes (46%), while variability of fruit stem length was in the highest percentage (36%) determined by interaction clone x year. If the clone x year is large for a character, like for the fruit stem length in this study, significant precision increases can be obtained only by replication over years (IEZZONI, 1986).

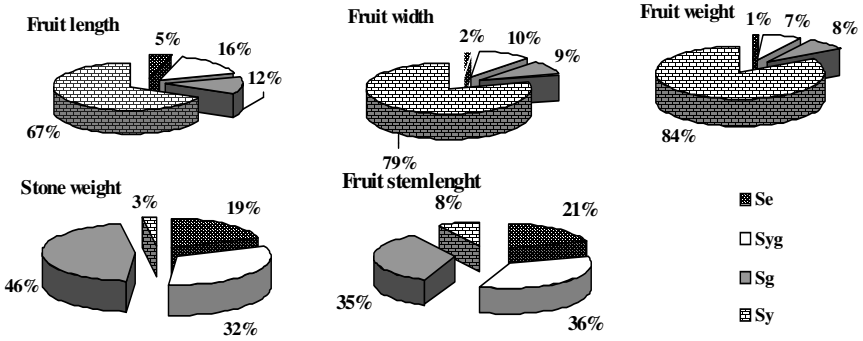


Fig. 1. - Components of total variability of pomologic characteristics for cultivar Montmorency clones

Differences between years of investigation (Figure 2.) influenced the most on total variability of soluble solid content, invert sugar content and total sugar content (89%; 77%; 83%, respectively). This is not in accordance with IEZZONI (1986) who determined that experimental error and accidental factors took the biggest part in total variability of soluble solid content in sour cherry. Variability of total acid content was influenced the most by accidental factors and errors during experiment (59%), but the lowest influence had differences between examined genotypes (3%). Chemical fruit characteristics are very specific properties, and greater number of replications is required to achieve the desired level of sensitivity. It is considered to be enough to take several samples from the same tree by dividing the crown of the tree into sectors (IEZZONI, 1986).

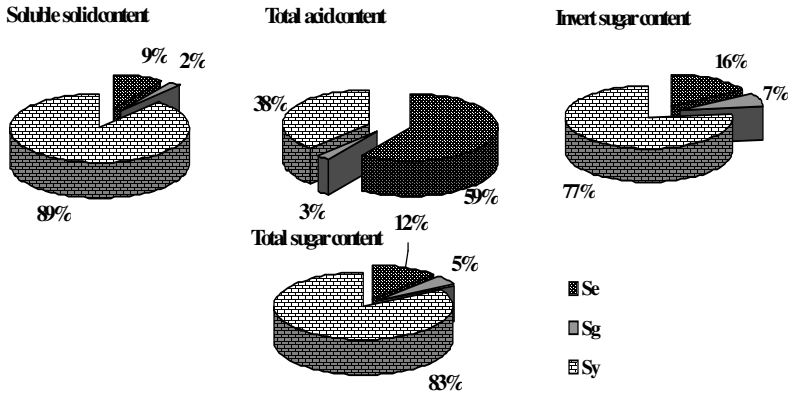


Fig 2. - Components of total variability of chemical characteristics for cultivar Montmorency clones

By comparing all examined pomologic characteristics (Table 2.), fruit weight had the highest coefficient of genetic and phenotypic variation ($CV_g$ = 11.41%; $CV_f$ = 13.86%, respectively), while the lowest had fruit length ($CV_g$ = 3.05%; $CV_f$ = 4.01%, respectively). Considering examined chemical properties, variability expressed by coefficients of variation, were the highest for invert sugar content ($CV_g$ = 4.92%; $CV_f$ = 7.34%). The lowest coefficient of genetic variation was calculated for total acid content ($CV_g$ = 1.79%), and the lowest coefficient of phenotypic variation was for soluble solid content ($CV_f$ = 4.51%).

*Table 2. - Coefficients of genetic ($CV_g$), phenotypic variation ($CV_f$) and coefficients of heritability in broader sense ($h^2$) for pomologic and chemical fruit characteristics for cultivar Montmorency clones*

| Characteristic | $CV_g$ | $CV_f$ | $h^2$ |
|---|---|---|---|
| Fruit length | 3.05 | 4.01 | 57.90 |
| Fruit width | 4.69 | 5.88 | 63.50 |
| Fruit weight | 11.41 | 13.86 | 67.75 |
| Stone weight | 9.63 | 11.49 | 70.27 |
| Fruit stem length | 7.26 | 9.17 | 62.58 |
| Soluble solid content | 2.69 | 4.51 | 35.52 |
| Total acid content | 1.79 | 6.45 | 7.73 |
| Invert sugar content | 4.92 | 7.34 | 44.90 |
| Total sugar content | 3.98 | 6.08 | 42.89 |

In examined pomologic properties, coefficients of heritability values are relatively high (Table 2.). The highest value was for stone weight (70.27%), and the lowest for fruit length (57.90%). These kinds of heritability coefficients values for pomologic characteristics are proof of environmental conditions low impact to demonstration of those properties. Besides that, its show possible improving of these characteristics by means of selection and using investigated genotypes in further breeding work. HANCHE *et al*. (1967) were examined sweet cherry cultivars and determined that heritability coefficient for fruit width was 47%, while for fruit stem length was 17%. Heritability coefficients for soluble solid content, total acid content, invert sugar content and total sugar content were below 50% which indicates that all four characteristics are under influence of environmental conditions. Heritability coefficients values ranged from 7.73% (total acid content) to 44.90% (invert sugar content). Even BASSI (1996) determined low heritability coefficient value for total acid content, but if apricot fruits.

## CONCLUSIONS

Between examined clones of cultivar Montmorency, clone 14 had the highest fruit width, the highest fruit weight and the highest stone weight. Clone 11 had the highest soluble solid content, and also the highest invert sugar content and total sugar content.

On total variability of fruit length, fruit width, fruit weight, soluble solid content, invert sugar content and total sugar content years of investigation had the highest influence, while the highest influence of genotype was determined for stone weight.

The highest coefficients of genetic and phenotypic variance were determined for fruit weight ($CV_g$ = 11.41%; $CV_f$ = 13.86%), while the lowest

coefficients of genetic variance was obtained for total acid content ($CV_g$ = 1.79%), and the lowest coefficients phenotypic variance for fruit length ($CV_f$ = 4.01%).

Coefficients of heritability varied from 7.73% for total acid content, up to 70.27% for stone weight.

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# KOMPONENTE VARIJABILNOSTI I HERITABILNOST POMOLOŠKIH I HEMIJSKIH OSOBINA KLONOVA VIŠNJE SORTE MONTMORENSI

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I z v o d

Kod 12 klonova višnje sorte Montmorensi ispitivano je 5 pomoloških (dužina ploda, širina ploda, masa ploda, masa koštice i dužina peteljke ploda) i 4 hemijske osobine (sadržaj rastvorljivih suvih materija, sadržaj ukupnih kiselina, sadržaj invertnih šećera i sadržaj ukupnih šećera). Na osnovu rezultata analize varijanse za sve ispitivane osobine izračunate su komponente varijabilnosti, koeficijenti genetičke i fenotipske varijacije i koeficijent heritabilnosti u širem smislu. Od komponenti ukupne varijabilnosti godina je predstavljala komponentu koja je u najvećem procenutu uslovila varijabilnost većine proučavanih osobina. Koeficijenti genetičke varijacije pokazuju da je kod proučavanih klonova najmanje varirao sadržaj ukupnih kiselina ($CV_g$ =1,79%), a najviše masa ploda ($CV_g$ =11,41%). Najmanje fenotipsko variranje ustanovljeno je za dužinu ploda ($CV_f$ =4,01%), a najveće za masu ploda ($CV_f$ =13,86%). Koeficijent heritabilnost bilo je najveći za masu koštice ($h^2$ = 70,27%), a najmanji za sadržaj ukupnih kiselina ($h^2$ = 7,73%).

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