UDC 575.21; 634.25
Original scientific paper

CORRELATIVE RELATION OF YIELD AND FRUIT QUALITY WITH SOME PHENOLOGICAL PHASES IN PEACH

Vera RAKONJAC

Faculty of Agriculture, Nemanjina 6, 11080 Belgrade-Zemun, Serbia and Montenegro

Rakonjac V. (2005): *Correlative relation of yield and fruit quality with some phenological phases in peach*. – Genetika, Vol. 37, No. 3, 199-207.

Ripening time of peach cultivars that are grown up in our country is extended over a time period of almost four months. In addition to that, one of more important objectives of the peach breeding is creation of the cultivars having either very early or very late ripening time. Our so far experience is that the peach cultivars which ripening time is in the extremes is of lower fruit quality. The aim of this study, therefore, was to determine relationship and the nature of the dependence between flowering time or ripening time from one side and yield, yield components (initial and final fruit set, fruit weight and stone weight) and chemical composition of fruit (content of total dry matter, content of soluble solids, content of total, invert and reduced sugar and content of total acid) on the other side. Twenty peach cultivars each having a different ripening time were using as material. The relationship between characteristics was determined on the basis of values of genetic and phenotypic correlation coefficients. Genetic and phenotypic coefficients of correlation were calculated based on the results of monofactorial analysis of covariance where the years considered as replications. It was confirmed that flowering time was positive genetic and phenotypic correlated with initial fruit set and with final fruit set. The existence of significant genetic and phenotypic correlation between ripening time and fruit weight, between ripening time and dry matter content and between ripening time and soluble solid con-

Corresponding author: Vera Rakonjac, Faculty of Agriculture, Nemanjina 6, 11080 Belgrade-Zemun, Serbia and Montenegro, e-mail: verak@agrifaculty.bg.ac.yu

tent represented difficulty in creation of new peach cultivars of early ripening time and improved fruit quality.

Key words: peach, yield, fruit quality, phonological phases, genetic and phenotypic coefficients of correlation

INTRODUCTION

The practice of peach breeding involves thorough knowledge of interrelations between characteristics, because the selection of promising genotypes is commonly performed on the basis of a larger number of characteristics. In addition, selection produces changes in interdependence between characteristics, so that examinations of values for genetic and phenotypic correlation coefficients must be done all the time.

The values for phenotypic correlation coefficients provide information about how much two characteristics are correlated but not about the character of that correlation. In principle, correlation is conditioned by genetic and ecological factors. It may also be the outcome of their mutual acting oriented to the same or opposite directions.

HANSCHE (1983) points out that correlation coefficient is a statistical measure indicating that two quantitative characteristics are tending to vary together. According to this author, the correlation between characteristics can be ascribed to the pleyotropic gene which may relate even to quantitative characteristics, or interrelations between linked major genes, where recombination is possible.

GINZBURG and NIKORO (1973) think that it is important to know the values of genetic correlation coefficients when the subject of selection is a complex characteristic that may be defined by a larger number of "simple" characteristics and in this case the effect of selection depends on both the mode of inheriting those characteristics and their genetic interrelation.

The maturing season of peach cultivars grown in this country spans nearly four months. Despite this fact, one of the important breeding goals is to develop very early maturing or very late maturing cultivars. Former experience has proved that peach cultivars of extreme maturing time are characterized by less good fruit quality. This was the reason why the aim of the present paper was to determine correlation and character of interdependence between flowering or maturing time, on the one hand, and yield components and fruit chemical composition, on the other hand.

MATERIAL AND METHODS

Studies were carried out in a collection peach orchard, ownership of PKB "Voćarske plantaze", Boleč. The trial was set up as mono-factorial and years were taken for replicates. Each year, five trees of the studied peach cultivars were monitored.

Trials comprised 20 peach cultivars of which 7 were standard peach cvs (Goldcrest, Iris Rosso, Domiziana, Emilia, Aurelia, Padana, Flaminia), 9 were

nectarine cvs (Mayfire, Weinberger, Croce del Sud, Pegaso, Venus, Nectaross, Andromeda, Vega, Sirio) and 4 were chilingstone peach cvs (Romea, Villa Adriana, Villa Ada and Villa Giulia).

Over a 3-year period, the characteristics monitored were as follows: flowering time, ripening time, initial fruit set, final fruit set, fruits, fruit and stone weight, yield, content of total dry matter, content of soluble solid, contents of total and invert sugars, sucrose content, and total acids content.

The date when 90% of flowers were open was taken for flowering time, and the date when harvest started was taken for maturing time (VITTRUP CHRISTENSEN, 1996). For biometric analysis, those two characteristics are expressed by the number of days against March 20. The initial fruit set was determined three weeks after flowering and final fruit set prior to harvest start. A sample of 20 fruits per tree was taken for measuring fruit and stone weight. Yield was found by weighing all fruits picked from the tree.

Total dry matter content was found by drying in a drier at 60^0C until constant weight was reached, and soluble solid content was determined by a refractometer. The contents of total and reducing sugars were determined by the Bertrand method, while sucrose content was obtained by computations as a difference between the contents of total and reducing sugars multiplied by coefficient 0.95. Total acids content was determined by neutralization with 0.1N NaOH. After multiplying by coefficient 0.0067 those acids are expressed as malic acid.

The significance of differences between cultivars for the studied characteristics was determined by the LSD test.

On the basis of monofactorial covariance analysis, where years were taken as replicates, genetic (r_g) and phenotypic (r_f) correlation coefficients were found using the formula:

$$r_{g_{xy}(f_{xy})} = \frac{COV_{g_{xy}(f_{xy})}}{\sqrt{S^2_{g_x(f_x)} \times S^2_{g_y(f_y)}}}$$

Correlation coefficients were tested by the t-test for 1% of risk level (**) using the formula,

$$t = \frac{r_{g_{xy}(f_{xy})}}{SE_{r_g(r_f)}}$$

where SE $r_g(r_f)$ was computed in the way as follows:

$$SE_{r_g(r_f)} = \frac{1 - r^2{}_{g_{xy}(f_{xy})}}{\sqrt{2}}$$

RESULTS AND DISCUSSION

On average, flowering time of peach cultivars over a 3-year study period was between April 9 and April 17, while ripening time was between June 16 and Sept. 21 (Fig. 1). It stems from these data that the flowering time variation interval amounted only to 8 days, whereas ripening time variation interval was as high as 3 months i.e. 99 days. VILEILA-MORALES *et al*. (1981) also found that in temperate

climate zones many peach cultivars tend to flower at the same time, and they say that the term fruit ripening time can be replaced by the length of fruit development period expressed as a number of days from full flowering to the first commercial harvesting.

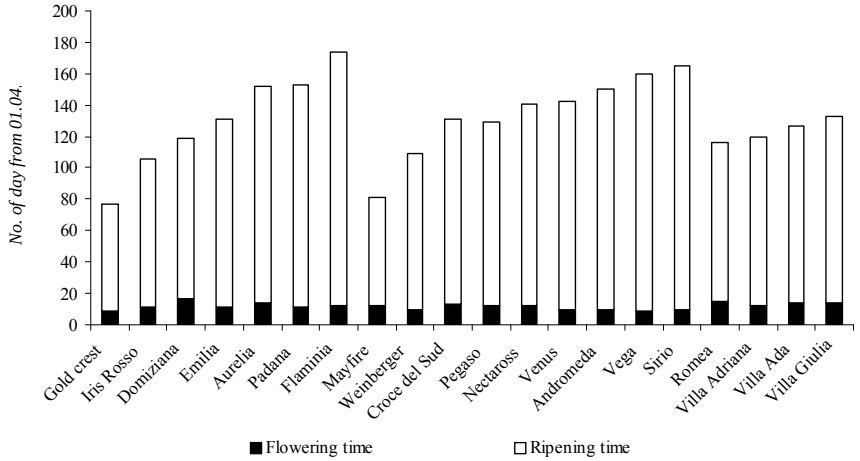

Fig. 1. Average values of flowering and ripening time in 20 peach cultivars for 3-year period

Variation in yield component and yield (CV=25.8-47.2%) was much more expressed than variation in indicators of fruit chemical composition (CV=7.8-12.8%). The differences manifested among peach cultivars were very significant for the majority of characteristics, except for soluble solid and total acids contents (Table 1).

The results presented in Table 2 indicate that there is positive, very significant genetic and phenotypic correlation between flowering time and initial fruit set (r_g=0.90**; r_f=0.75**) as well as between flowering time and final fruit set (r_g=0.87**; r_f=0.67**). Higher level of fruit setting in later flowering peach cultivars is most likely due to a lower risk of winter killing in fruit buds of those cultivars, therefore the number of fruit set is higher. As reported by SZABO *et al.* (1998), who also found correlation between flowering time and degree of damage in fruit buds, this need not affect yield since this characteristic is not only influenced by the level of winter killing but also by fruit bud density. The results reported by the authors mentioned are confirmed by ours in the present paper, because correlation coefficients between flowering time and yield were not significant.

Genetic correlation coefficients between flowering time and total dry matter content (r_g=0.82**) and flowering time and soluble solid content (r_g=0.85**) were very significant. Phenotypic correlation coefficients between mentioned characteristics were not statistically significant, which indicates that interdependence of those characteristics is largely influenced by environmental

factors acting in direction opposite to genetic factors, so that genetic correlation did not manifest itself in phenotype. TOPP and SHERMAN (1989) reported that correlation between some peach characteristics can be conditioned by climatic factors too.

Table 2. Genetic (r_g) and phenotypic (r_f) coefficients of correlation between flowering time or ripening time from one side and yield components, yield and chemical composition of fruit on the other side

Characteristic	Flowering time		Ripening time	
	r_g	r_f	r_g	r_f
Initial fruit set	0.90**	0.75**	-0.32	-0.29
Final fruit set	0.87**	0.67**	-0.25	-0.23
Fruit weight	0.16	0.19	0.66**	0.60**
Stone weight	-0.16	-0.12	0.93**	0.91**
Yield	-0.11	0.03	0.37	0.27
Total dry meter	0.82**	0.42	0.75**	0.59**
Soluble solid	0.85**	0.37	0.89**	0.56**
Total sugars	0.27	0.24	0.08	0.08
Invert sugars	0.16	0.11	0.17	0.14
Sucrose	0.07	0.11	0.04	0.04
Total acids	0.46	0.24	-0.18	-0.09

** 1% level risk

Positive, statistically very significant genetic and phenotypic correlation was found between ripening time and fruit weight (r_g=0.66**; r_f=0.60**), ripening time and stone weight (r_g=0.93**; r_f=0.91**), ripening time and total dry matter content (r_g=0.75**; r_f=0.59**), as well as between ripening time and soluble solid content (r_g=0.89**; r_f=0.56**). HESSE (1975) also reports that there is significant correlation between peach ripening time and fruit size (r=0.41-0.50). DE SOUZA *et al*. (1998), using values of correlation coefficients, found genetic and phenotypic correlation between ripening time and soluble solid content (r_g=0.63; r_f=0.41), and also total acids content (r_g=0.55; r_f=0.32) but not fruit weight (r_g=0.21; r_f=0.08), which is in partial agreement and disagreement with the results reported herein.

RODRIGEZ *et al.* (1986) who found significant correlation between the length of fruit development period and peach fruit weight do not consider this phenomenon the result of linked genes but think it is most likely of physiological character. The emergence of those correlations can be explained via the difference in stage III of fruit development in cultivars of different ripening time. In later ripening peach cultivars longer duration of this development stage results in larger fruit weight and higher content of various types of matter in a fruit, because the volume of cells is increased due to water and other matter storing. This hypothesis can be confirmed by interpretations of SOUTY *et al.* (1998) who report that the length of fruit development period and course of assimilates flow influence both fruit size and fruit organoleptic quality. The existing significant genetic and phenotypic correlations between mentioned characteristics present difficulty in developing peach cultivars of early maturing time and better fruit quality. The fact that, on the other

hand, the existing genetic correlations between two characteristics need not always manifest themselves on phenotype, depending on the course of their acting and intensity of non-genetic factors influence, indicate that by finding out the optimum growing conditions for early maturing cultivars their quality can be improved too.

CONCLUSION

In studied peach cultivars the flowering time variation interval amounted to 8 days, while the maturing time variation interval equaled 99 days.

The manifested differences between peach cultivars were very significant for most characteristics, except for soluble solid and total acids contents.

Very significant genetic and phenotypic correlation was found between flowering time and initial fruit set (r_g=0.90**; r_f=0.75**) as well as between flowering time and final fruit set (r_g=0.87**; r_f=0.67**), therefore higher level of fruit setting is possessed by later maturing peach cultivars.

The existence of significant genetic and phenotypic correlation between ripening time and fruit weight (r_g=0.66**; r_f=0.60**), between ripening time and dry matter content (r_g=0.75**; r_f=0.59**) and between ripening time and soluble solid content (r_g=0.89**; r_f=0.56**) represented difficulty in creation of new peach cultivars of early ripening time and improved fruit quality.

Received May 16th, 2005
Accepted June 1st, 2005

REFERENCES

De SOUZA V.A.B., D.H. BYRNE, and J.F. TAYLOR (1998): Heritability, genetic and phenotipic correlations and predicted selection response of quantitative traits in peach: II An analysis of several fruit traits. J.Amer.Soc.Hort.Sci., *123* (4), 604-611.

GINZBURG E.H. and E.S. NIKORO (1973): K voprosu o genetičeskih korelacijah. Soobšćenie I Plejotropija i neravnomernost. Genetika, *9*, 45-54.

HANSCHE P.E. (1983): Response to selection. p. 154-171. *In*: Moore, J.N. and J. Janick (eds.) Methods in fruit breeding. Purdue Univ. Press, West Lafayette, Indiana.

HESSE C.O. (1975): Peaches. p. 285-335. *In*: Janick, J. and J.N. Moore (eds.) Advances in fruit breeding, Purdue Univ. Press, West Lafayette, Ind.

RODRIGUEZ J., A. WAYNE, B. SHERMAN, and P.M. LYRENE (1986): High-density nursery system for breeding peach and nectarine: a 10-year analysis. J.Amer Soc. Hort. Sci., *111*, 311-315.

SOUTY M., G. REICH, G. ALBAGNAC, and M. GENARD (1998): Quality of peach fruit in relation to carbon supply. Acta Horticulturae, *465* (2), 481-489.

SZABO Z., J. NYEKI, I. SZEL, A. PEDRUC AND L. SZALAY (1998): Low temperature injury in peach and nectarine cultivars. Acta Horticulturae, *465*, 399-404.

TOPP B.L. and W.B. SHERMAN (1989): Location influences on fruit traits of low chil peaches i n Austarlia. Proc.Fla.State Hort.Sci., *102*, 195-199.

VILEILA-MORALES E.A., W.B. SHERMAN, C.J. WILCOX, and C.P. ANDREWS (1981): Inheritance of short fruit development period in peach. J. Amer. Soc. Hort. Sci., *106*, 399-401.

VITTRUP CHRISTENSEN J. (1996): Flowering period of 175 sweet cherry cultivars with regard to cross pollination possibilities. Acta Horticulturae, *423*, 39-47

KORELACIONA POVEZANOST PRINOSA I KVALITETA PLODA BRESKVE SA NEKIM FENOLOŠKIM FAZAMA

Vera RAKONJAC

Poljoprivredni fakultet, Nemanjina 6, 11080 Beograd-Zemun, Srbija i Crna Gora

Izvod

Vreme sazrevanja sorti breskve koje se gaje u našoj zemlji proteže se gotovo na četiri meseca. I pored toga, jedan od važnih ciljeva u oplemenjivanju ove vrste voćaka je stvaranje sorti veoma ranog ili veoma kasnog vremena sazrevanja. Dosadašnje iskustvo pokazalo je da se sorte breskve ekstremne po vremenu sazrevanja odlikuju slabijim kvalitetom plodova. Upravo stoga, cilj ovog rada je bio da se utvrde relacije i priroda zavisnosti vremena cvetanja ili vremena sazrevanja s jedne strane i prinosa, komponenti prinosa (broj zametnutih i broj ubranih plodova, masa ploda i masa koštice) i hemijskog sastava plodova (sadržaj ukupnih i rastvorljivih suvih materija, sadržaj ukupnih invertnih i redukujućih šećera i sadržaj ukupnih kiselina) s druge strane. Kao materijal korišćeno je 20 sorti breskve različitog vremena sazrevanja. Povezanost osobina utvrđena je na osnovu vrednosti koeficijenata genetičke i fenotipske korelacije. Koeficijenti genetičke i fenotipske korelacije izračunati su na osnovu rezultata monofaktorijalne analize kovarianse, gde su godine uzete kao ponavljanje. Ustanovljeno je da je vreme cvetanja bilo pozitivno i veoma značajno genetički i fenotipski korelisano sa brojem zametnutih plodova i brojem ubranih plodova. Postojanje značajnih genetičkih i fenotipskih korelacija između vremena sazrevanja i mase ploda, vremena sazrevanja i sadržaja ukupnih suvih materija i vremena sazrevanja i sadržaja rastvorljivih suvih materija predstavlja teškoću u stvaranju sorti breskve ranog vremena zrenja sa poboljšanim kvalitetom ploda.

Primljeno 16. V 2005.
Odobreno 1. VI 2005.