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Marked Improvement of Hungarian Sour Cherries by Cross-Pollination II: Fruit Quality

M. Ansari and G.H. Davarynejad
Department of Horticulture, Ferdowsi University of Mashhad, Iran

Abstract: The effects of pollens introduced from 6 sweet and sour cherry cultivars (*Siah mashhad* sweet cherry, *shishei* sweet cherry, local sour cherry and *Érdi bötermö*, *Érdi jubileum* and *Cigány meggy* sour cherry) were studied on fruit properties of three Hungarian sour cherry cultivars (*Érdi bötermö*, *Érdi jubileum* and *Cigány meggy*) grown under Mashhad, Iran climatic conditions. The results showed relative variation in Hungarian sour cherry fruits as affected by pollen sources. Pollens of *Siah mashhad* as paternal choice had better effects were gave high quality of maternal tree fruits compared to control and other pollen donors. Pollens of *Siah mashhad* caused the increase of fruit size in *Cigány meggy* cultivar, as well as reduction in total soluble solids of *Érdi bötermö* fruits, however, it does not have significant effect on the qualitative traits of *Érdi jubileum* fruits.

Key words: Sour cherry, total soluble solids, titratable acid, *Érdi bõtermõ*, *Érdi jubileum*, *Cigány meggy*

INTRODUCTION

Sour cherry fruit is a drupe, round or heart-shaped, glabrous, with pedicel attached. Sour cherries generally have lower sugars and higher organic acid contents than sweet cherries, giving them their distinct flavors. They are generally bright red in color and exhibit less color variation than sweet cherries. The trade between different countries of sour cherry for fresh consumption is relatively a minor item (scarcely more than 40 thousand tons) in relation to the whole volume produced of that fruit.

Two reasons are mentioned: The more decisive one means that the sour cherry being processed into many different commodities, which reach the consumers and does not mean the consumers one sided demands, but rather the (world wide) reduced supply of varieties also suitable for fresh consumption. The second commonly known reason is that fresh consumption is largely covered mainly by the home grown contingent of fruit, which means also that where sour cherry can not be grown, the consumers must renounce of this pleasure and of a most healthy food (Nyéki *et al*., 2005).

As mentioned earlier, most of sour cherry production worldwide sent for processing cycle which processed into canned sour cherry compote or desiccation. So, working on fruit properties of sour cherry cultivars via using different pollinisers could result in probable high quality fruits which are attractive for food processing factories and fresh consumption also. The qualitative characteristic features of sour cherry which released by Apostol (1996) are shown in Table 1.

Results of Voca *et al*. (2008) on strawberry showed that parameters like Total Acids (TA), Total Soluble Solids (TSS) and their ratio (TSS/TA) are very important in determining fruit quality. They showed that Total Soluble Solids to Total Acid ratio is a very important parameter in evaluating fruit quality, because it determines fruit flavor harmony.

According to the research of Sturm *et al*. (2003), the TSS/TA ratio in strawberry, depending on harvest time, is considered to be very high. Results of Druzic *et al*. (2007) on fruit quality of plum cultivars showed the importance of evaluating of TSS, TA and their ratio and also the effects of these qualitative traits on resistance and tolerance of fruits against diseases.

The effect of metaxenia has reported on fruit size (Cociu and Gozob, 1962), fruit ingredients (Nyeki, 1980) and fruit sugar, acidity and vitamins of sweet and sour cherry cultivars.

According to Apostol *et al*. (1977), metaxenia in sweet cherry is insignificant and does not consider as a factor for cultivar combination. Meanwhile, Terpo *et al*. (1978a, b) mentioned the necessity of metaxenia studies for defining probable cultivar combination.

Table 1: Characteristics of the main sour cherry varieties in Hungary (Apostol, 1996)

Variety	Ripening date (mo day^{-1})	Diameter (mm)	Total soluble solids (%)	Acidity (%)
Eedi jubileum	June 12-30	21-23	18-22	1.5-2.2
Érdi bötermö	June 18-20	22-24	15-17	1.0-1.5
Cigany clones	June 18-23	14-20	13-18	1.4-2.2

Corresponding Author: G.H. Davarynejad, Department of Horticulture, Ferdowsi University of Mashhad, Iran

The objective of this study was to evaluate the effect of various pollen sources from sweet and sour cherry cultivars in Iran on fruit properties of three Hungarian sour cherry cultivars (*Érdi bõtermõ*, *Érdi jubileum* and *Cigány meggy*) planted in Mashhad, Iran climatic condition. Such study will help in selecting of pollen donor cultivars that can produce better fruit qualities of these three cultivars.

MATERIALS AND METHODS

The study was conducted during 2006 on three Hungarian sour cherry cultivars (*Érdi bötermö, Érdi jubileum* and *Cigány meggy*) of about 15 years old grown in loamy soil at Mashhad, Iran.

In order to studying the qualitative and quantitative traits of fruits obtained from different methods of pollination, an experiment was set up according to completely randomized block design with 6 treatment and 4 replication. Statistical analysis were carried out on the percentages of fruit set obtained from different cross and self pollinations with the use of SAS and EXCEL software's.

In order to study the cross and self pollination for every polliniser variety, in balloon stage, four branches were chosen from several maternal trees and isolated with paper bags. All observations were calculated in percentage scale (data related to final fruit set percentages), Arc-Sinus transformation was carried out on the data.

Final fruit set percentage in each pollination treatment including open pollination, natural and artificial self pollination and cross pollination calculated and fruits were taken to the lab for measuring. Qualitative and quantitative characteristics such as fruit dimensions including fruit length and fruit diameter and fruit shape index, total soluble solids and acidity of fruits measured in the lab. Determination of total soluble solids was conducted by reading of soluble solids directly from the refractometer. Determination of total acidity was based on potentiometric titration with the solution of sodium hydroxide. Finally the ratio of TSS/TA that is important in defining the fruit quality was calculated.

These Hungarian sour cherry cultivars were used as reciprocal male and female cultivar. *Siah mashhad*, *Shishei* sweet cherry and also local sour cherry were used only as pollen donor cultivars.

RESULTS AND DISCUSSION

***Érdi bötermö*:** The qualitative and quantitative traits of *Érdi bötermö* obtained from cross pollination are shown in Table 2. None of polliniser cultivars have significant effect on the fruit shape of *Érdi bötermö* and there is not any significant difference with self pollination as control treatment. If we consider artificial self pollination as control treatment, we see that none of cross pollination treatments could give satisfactory fruit quality from the viewpoint of total soluble solids (Table 2). In the case of artificial self pollination, the brix index for *Érdi bötermö* is 16.55 g/100 g. All cross pollination treatments showed lower brix index than control treatment (artificial self pollination). Cociu and Gozob (1962) proved the effects of metaxenia phenomenon on the fruit size of sour cherry varieties.

Results showed that all cross pollination treatments partially caused reduction in total soluble solids (brix index) of *Érdi bötermö* fruits (Table 2). Of course, we could not connect all innovations to the effects of metaxenia, because according to Tustin *et al.* (1988) several factors could effect on the qualitative and quantitative characteristics of fruits. For example dangle branches set lower fruits which are often smaller and with lower quality than horizontal branches or branches with acute angle. Also, the fruit position on the tree crown hardly affects on the fruit characteristics.

About titratable acid of the fruits, as we seen, cross pollination treatments such as *Shishei* and local sour cherry, in addition to consequent low fertility in *Érdi bötermöt*, caused reduction in fruit quality via change in equilibrium between acidity and total soluble solids of fruits.

Table 2: Qualitative and quantitative traits of *Érdi bötermö* cultivars obtained from cross pollination with pollinisers

Pollen donor cultivars	Fruit shape index (length diameter^{-1})	Fruit diameter (mm)	Fruit length (mm)	Total soluble solids (Brix) (%)	Titratable acid	TSS/TA	Final fruit set
Shishei sweet cherry	0.88a	20.63abc	18.22ab	14.94c	1.38a	10.93cd	0.66d
Local sour cherry	0.85a	21.43a	18.25ab	14.28c	1.36a	10.58d	3.71cd
Siah mashhad sweet cherry	0.87a	21.70a	18.81a	15.13bc	1.26ab	12.13b	17.91a
Cigány meggy	0.88a	20.03bc	17.68bc	16.00ab	1.33ab	12.15b	5.79bcd
Érdi jubileum	0.89a	19.36c	17.17c	14.75c	1.31ab	11.38c	2.63cd
Érdi bötermö (self pollination)	0.87a	20.95ab	18.21ab	16.55a	1.21b	13.80a	7.26bc

Average with the same letters (s) in each columns are not significantly different in LSD = 0.05

But cross pollination of *Érdi bötermö* by *Siah mashhad* sweet cherry resulted in rather high fertility in addition to good equilibrium between total soluble solids and titratable acid of fruits. The lack of balance between total soluble solids and titratable acid in fruits could causes undesired changes in fruit taste and finally reducing the marketing quality. Meanwhile, the existence of balance between the ingredients of fruits is highly important from the viewpoint of processing industry.

According to Voca *et al*. (2008) the relationship between total soluble solids and total acidity is very important in determining fruit quality, because it provides information on the balance of sugars and acids in the fruits.

Results of TSS/TA ratio in *Érdi bötermö* cultivar obtained from different cross pollinations and comparison with control treatment (self pollination) showed that none of pollen donors could reach the higher TSS/TA ratio than control treatment of self pollination. The remarkable point in all 3 varieties (*Érdi bötermö*, *Érdi jubileum* and *Cigány meggy*) is the negative effects of local sour cherry on the TSS/TA ratio.

Totally, local sour cherry fruits are small and are not of important value in Iran. Results of fruit quality and quantity in present experiments showed that we should not use this variety (local sour cherry) as a pollen donor, at least, for these 3 Hungarian sour cherry varieties.

***Cigány meggy*:** The effects of pollen donors on the qualitative and quantitative traits of *Cigány meggy* fruits shown in Table 3. *Siah mashhad* sweet cherry as polliniser, had significant effect on the fruit length of *Cigány meggy* cultivar. The average fruit length of *Cigány meggy* in control treatment (artificial self pollination) was 17.05 mm which was 20.21 when cross pollinated with *Siah mashhad* pollens. In fact *Siah mashhad* pollens leading to increase of *Cigány meggy* fruit size.

The comparison of total soluble solids of *Cigány meggy* fruits obtained from cross pollination with different pollinisers, showed the advantage of *Siah mashhad* compare with other pollinisers (Table 3). Although *Siah mashhad* pollens caused partially reduction in titratable acid of *Cigány meggy* fruits and totally induced proper equilibrium between titratable acid and total soluble solids of fruits.

Natural lower TSS and higher TA of *Cigány meggy* cultivar in comparison with the two other cultivars caused the lower TSS/TA ratio of *Cigány meggy* cultivar. Altogether, *Érdi jubileum* and local sour cherry caused the reduction of TSS/TA ratio, when *Érdi bötermö, Siah mashhad* and *Shishei* sweet cherry caused increase of TSS/TA ratio in *Cigány meggy* fruits.

Finally, according to the percentage of fruit set (25.83%) and also the qualitative traits of fruits, *Siah mashhad* sweet cherry was the best polliniser for *Cigány meggy* sour cherry. While there was more than 50% overlap of flowering between two cultivars.

***Érdi jubileum*:** Results showed that pollinisers had no considerable effect on the fruit shape of *Érdi jubileum* sour cherry (Table 4). Pollens of *Shishei* sweet cherry caused significant increase in total soluble solids of *Érdi jubileum* sour cherry while local sweet cherry and *Sigány meggy* pollens caused significant reduction. Also *Shishei* sweet cherry as polliniser caused the significant reduction of titratable acid of *Érdi jubileum*

Table 3: Qualitative and quantitative traits of *Sigány meggy* cultivars obtained from cross pollination with pollinisers

Pollen donor cultivars	Fruit shape index (length/diameter)	Fruit diameter (mm)	Fruit length (mm)	Total soluble solids (Brix) (%)	Titratable acid	TSS/TA	Final fruit set
Shishei sweet cherry	0.88b	18.58a	16.23b	14.76a	1.67c	8.80c	22.01ab
Local sour cherry	0.87b	20.29a	17.63b	14.73a	1.79b	8.28e	21.93ab
Siah mashhad sweet cherry	1.00a	20.21a	20.21a	16.24a	1.81b	9.00b	25.83a
Érdi bötermö	0.87b	19.48a	17.02b	15.36a	1.57d	9.80a	23.72ab
Érdi jubileum	0.89b	18.50a	16.38b	14.43a	1.89a	7.65f	12.93b
Cigány meggy (Self pollination)	0.85b	19.95a	17.05b	15.80a	1.85ab	8.55d	28.72a

Average with the same letter (s) in each columns are not significantly different in LSD = 0.05

Table 4: Qualitative and quantitative traits of *Érdi jubileum* cultivars obtained from cross pollination with pollinisers

Pollen donor cultivars	Fruit shape index (length/diameter)	Fruit diameter (mm)	Fruit length (mm)	Total soluble solids (Brix) (%)	Titratable acid	TSS/TA	Final fruit set
Shishei sweet cherry	0.88b	18.58a	16.23b	14.76a	1.67c	8.80c	22.01ab
Shishei sweet cherry	0.86a	21.01a	18.12a	21.11a	1.61de	13.13a	11.76ab
Local sour cherry	0.85a	20.24a	17.13a	18.39cd	1.91a	9.63d	10.21ab
Siah mashhad sweet cherry	0.84a	20.81a	17.40a	19.48bc	1.65cd	11.80b	15.22a
Érdi bötermö	0.85a	21.09a	18.04a	18.69bcd	1.56e	12.00b	6.16ab
Cigány meggy	0.86a	20.21a	17.42a	17.90d	1.69c	10.60c	10.84ab
Érdi jubileum (self pollination)	0.85a	20.40a	17.42a	19.80b	1.83b	10.83c	10.52ab

Average with the same letter (s) in each columns are not significantly different in LSD = 0.05

fruits. The use of *Siah mashhad* as paternal tree for *Érdi jubileum*, lead to significant reduction in titratable acid of fruits in comparison with artificial self pollination.

Like the two other mentioned varieties, local sour cherry as a pollen donor caused the lowest ratio of TSS/TA. Also *Cigány meggy* cultivar was not good from the viewpoint of TSS/TA ratio.

In this cultivar (*Érdi jubileum*), *Shishei* sweet cherry was the best polliniser from the viewpoint of TSS/TA ratio and showed significant difference with control treatment (self pollination). *Érdi bötermö* sour cherry and *Siah mashhad* sweet cherry showed significant difference of TSS/TA ratio with control treatment.

Focusing on the final fruit set obtained from cross pollination and fruit quality; in general, *Siah mashhad* and *Shishei* sweet cherry were the best pollen donors for *Érdi jubileum* among the pollinisers used in this experiment. Although the final fruit set by these two pollinisers was not significantly different with the results of artificial self and open pollination.

Finally, it could be deducted from the results of natural self pollination that under Mashhad, Iran climatic conditions during 2005 and 2006, these three sour cherry cultivars (*Érdi bötermöt*, *Érdi jubileum* and *Cigány meggy*) classified into partially self fertile group and should consider suitable polliniser for them. Studying the results of experiment showed the high combining ability and improving quality of *Siah mashhad* and *Shishei* sweet cherry which could be used for improving the fertility situation of Hungarian sour cherry cultivars in Mashhad climatic conditions.

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