Morphological and phenological properties of sour cherry varieties grown in Hungary and their inter-incompatibility relations

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Summary: Regular observations and experiments were performed during a 14 year period on 6 sour cherry varieties. The morphological traits of leaves and fruits were compared, and the phenology of blooming as well as of ripening dates served to start an estimation of the possibilities of mutual pollination and the planning of harvest operations. Experiments involved obligate autogamy, artificially controlled allogamy and open pollination in order to reveal self-fertility, self-sterility or inter-incompatibility relations.
The varietal characters represent, each, different values in the distinction of the items, because of their intra-varietal variability. From that point of view, the most reliable are the data of blooming and ripening time, fruit size and the fertility relations.
Inter-incompatibility was observed between the group of self-fertile, "Pándy type" varieties (*'Újfehértói fürtös, Debreceni bőtermő, Kántorjánosi'*) on one side and the selection of *'Pándy 7'*, a self-sterile variety on the other side. Unilateral incompatibility has been detected within the former group of new, self-fertile varieties, the combinations: *'Újfehértói fürtös x Debreceni bőtermő'*, as well as *'Újfehértói fürtös x Kántorjánosi'*.
Our results prove the close kinship between those three new varieties and the original Pándy variety on the base of being highly similar in their morphology and also of the fact of their inter-incompatibility, though unilateral.

Introduction

Hungary disposes of a rich *assortment* of sour cherries derived partially from the selection of native or local varieties, on the other hand from a purposeful breeding programme (*Apostol* 1996). During the last twenty years in East-Hungary, several varieties have been registered similar to the best, large (above 20 mm diameter), excellent quality „Pándy" variety, but self-fertile. Most popular of them are the *'Újfehértói fürtös'*, *'Debreceni bőtermő'*, and *'Kántorjánosi'* (*Szabó* 1996).

The detailed morphological and phenological characterisation of those new varieties was the purpose of our study as well as the determination of kinship between them. Earlier experimental crosses between the Pándy variety and the self-fertile Pándy-type varieties (*'Újfehértói fürtös, Debreceni bőtermő, Kántorjánosi'*) indicate genetic relations. (*Apostol, Nyéki, Szabó* 1996, *Nyéki* and *Szabó* 1996).

Materials and methods

During the period between 1983 and 1996, the traditional sour cherry growing region of N-E Hungary was the site of experiments with the 6 most important varieties. Observations were made on the morphology (leaves, fruits), phenology (blooming date, ripening date) and on the fertility relations.

Results

3.1. Blooming date

Comparison of blooming dates is possible throughout the 13 year period as presented in Table 1. Beginning, main time and the end of the flowering period were marked each time. The three Pándy-type, self-fertile varieties (*Újfehértói fürtös, Kántorjánosi, Debreceni bőtermő*) are rather similar in their blooming phenology and differ from the rest of varieties. In all those characteristic dates there was hardly more than one day difference in most seasons as well as in the mean of the 13 years. Important differences were observed only in the first year on the 4 year old trees, as the main blooming and the end of blooming of the variety Kántorjánosi was later by 6 days than the other two related varieties. To the three varieties only the Sárándi S/GY was near in blooming dates.

The variety *Cigánymeggy 7* started 1–2 days earlier and ended 3–4 days earlier than the self-fertile Pándy-type varieties.

Pándy meggy 279 was by 1–2 days later in all phases of the blooming period than the three Pándy-type self fertile varieties, whereas the length of the blooming period was equal.

During the 13 years there were early and late blooming seasons but the three Pándy-type varieties did not differ in their dates from each other. The 6 varieties observed are distributed into three groups according to their blooming dates:

Early	Cigánymeggy 7
Medium	Újfehértói fürtös, Kántorjánosi, Debreceni bőtermő, Sárándi S/GY
Late	Pándy 279

3.2. Date of ripening

The ripening of the sour cherry varieties varied much more than their blooming as seen in *Table 1*. The dates of *Cigánymeggy 7* was observed during five years, two times later, three times earlier in ripening than *Újfehértói fürtös.*

Pándy meggy 279 ripened earlier (five times), at the same time (once) or one day later (once) than *Újfehértói fürtös.*

Characteristic ripening date of the variety cannot be determined reliably but on the base of a longer period (10 years).

3.3. Leaf characters

Similar size and form of the leaves are found in *Pándy 279* and in the Pándy-type self-fertile varieties (*Table 2*).

Smaller leaves are typical for *Sárándi S/GY* and *Cigánymeggy 7*. The petioles of *Sárándi S/GY* are relatively longer compared with the size of leaves.

It was generally true that larger leaves used to be combined with shorter petioles, within the varieties.

Table 1 Blooming and ripening dates of sour cherry varieties (means of observations made during 1983–1995 at Újfehértó)

Variety	Mean of 13 years					
	1	2	3	4	5	6
Újfehértói fürtös	Apr 21	Apr 25	May 2	12	July 8	June 30 - July 24
Kántorjánosi	Apr 21	Apr 25	May 2	12	July 9	June 30 - July 24
Debreceni bőtermő	Apr 21	Apr 26	May 3	13	July 9	June 28 - July 20
Sárándi S/GY	Apr 21	Apr 27	May 3	13	June 23	June 12 - July 3
Cigánymeggy 7	Apr 18	Apr 21	Apr 26	9	July 5	June 26 - July 20
Pándy meggy 2/9 (check)	Apr 19	Apr 24	Apr 30	13	July 3	June 27 - July 12
Mean of varieties	Apr 21	Apr 25	May 2	11	July 4	June 26 - July 15

Legend : 1 = Start of blooming, 2 = Main blooming, 3 = End of blooming, 4 = Length of the blooming period in days, 5 = Mean date of ripening, 6 = Extreme dates of ripening during the 13 year period

Table 2 Leaf characters of sour cherry varieties (Újfehértó, 1996)

Variety	Length of leaf blade (mm)	Width of leaf blade (mm)	Length/ width ratio of leaf blade	Length of the petiole (mm)
Pándy 279	113.1	54.4	2.08	18.4
Újfehértót fürtös	119.4	59.8	2.00	17.9
Debreceni bőtermő	103.6	56.7	1.83	19.1
Kántorjánosi	112.2	54.7	2.05	18.5
Sárándi S/GY	95.8	51.3	1.87	20.7
Cigánymeggy 7	77.4	39.5	1.96	15.3

3.4. Fruit characters

According to the size of fruit three categories are formed. Large fruits are grown on *Pándy 279*, medium size (one gram less mass and 2 mm less diameter) is for the three Pándy type, self-fertile varieties, whereas small fruits are found in *Sárándi S/GY* and *Cigánymeggy 7* (*Table 3*). The measures of the stones were relatively equal with the measures of the whole fruits.

Table 3 Fruit characteristics of the sour cherry varieties (1995, Újfehértó)

Variety	Fruit diameter (mm)	Fruit mass (g)	Stone mass (g)	Stone ratio (%)	Fruit shape length/diam	Stone shape length/diam	Fruit stem (mm)	Stipule length (mm)
Pándy meggy 279	24.7	6.5	0.44	6.77	0.88	1.24	45.4	1.4
Újfehértói fürtös	22.8	5.5	0.36	6.55	0.88	1.19	47.8	0.9
Debreceni bőtermő	22.3	5.3	0.35	6.60	0.88	1.23	46.5	0.9
Kántorjánosi	22.8	5.6	0.39	6.96	0.87	1.21	50.7	1.1
Sárándi S/GY	19.7	3.9	0.25	6.41	0.91	1.26	39.8	0.7
Cigány meggy 7	19.6	3.8	0.33	8.68	0.89	1.10	49.2	0.2
Mean of the six varieties	*21.9*	*5.1*	*0.35*	*6.86*	*0.88*	*1.20*	*46.6*	*0.8*

Újfehértói fürtös, Kántorjánosi and *Debreceni bőtermő* were identical on the average of 13 years (July 8-9), the seasonal variation extended to 6 days.

Sárándi S/GY ripened earlier by 8–27 days, on the average by 15 days than *Újfehértói fürtös.*

The stones were relatively larger in *Cigánymeggy 7* (8.6%), as the stones were smaller in the rest of varieties (6.6–7.0%).

As for the length of the fruit stem (peduncle), *Sárándi*

Table 4 Fertility of sour cherry varieties after autogamy and open pollination (Újfehértó)

Variety ♀	Mean number of isolated flowers yearly	Ratio of fruits set by autogamy %	Mean number of flowers observed yearly	Ratio of fruits/ flowers set by free pollination %
Újfehértói fürtös	169	7.0	770	25.2
Kántorjánosi	181	5.4	666	21.1
Debreceni bőtermő	170	6.2	696	26.9
Sárándi S/GY	176	6.6	736	20.6

Remark: The data presented are means of 11 year long observations

S/GY had shorter ones than the others.

The form index (length per width) of the fruits was similar in *Pándy 279* and the Pándy-type, self-fertile varieties. Fruits of *Sárándi S/GY* and *Cigánymeggy 7* are less flat than the former ones.

The three Pándy-type self-fertile varieties cannot be distinguished on the basis of the form indices of stones. *Pándy 279* and *Sárándi S/GY* stones are somewhat elongated, whereas *Cigánymeggy 7* stones are less elongated.

3.5. Fertilisation

Fruit set of the four varieties observed did not attain 10% on the average by self fertilisation. There was no one season which produced 20% fruit set necessary for an abundant yield (*Table 4*). None of those varieties is considered to be sufficiently self fertile from an economic point of view.

Free pollination produced in all the four varieties more than 20% fruit set, i.e. bee pollination will secure the yield if adequate pollinizers are at hand (*Table 5*).

Table 5 Inter-fertility of sour cherry varieties as the ratio of fruit set in the respective combinations (Újfehértó, 1992, 1993)

Male parent Female parent	Újfehértói fürtös	Debreceni bőtermő	Kántor-jánosi	Open pollination
Újfehértói fürtös	49.3	0.8	0	27.3
Debreceni bőtermő	40.0	34.6	27.0	37.6
Kántorjánosi	44.6	49 .7	37.4	25.8

Remark: In cross combinations the ratios are calculated yearly on 30–70 flowers
Fruit set ratios in open pollination are based yearly on 394–593 flowers

The seasons (i.e. environmental hazard of the conditions of pollination) produced a wide range of variation in fruit set.

Experimental crosses were performed at two sites (*Table 6 and 7*). The self-fertile, Pándy-type varieties proved to be poor pollinizers of *Pándy 7*, in turn, the reciproc combinations did not produce adequate sets, either. *Újfehértói fürtös* was an insufficient pollinizer for *Debreceni bőtermő* and *Kántorjánosi*. *Újfehértói fürtös*, however, bore abundant fruit as a female in this combination. Those three varieties gave sufficient yield in the rest of combinations at Újfehértó.

Table 6 Inter-fertility relations of sour cherry varieties as mean fruit set ratios % (Helvécia)

Pollinizer **Varieties** Female	Number of years observ.	Pándy 7	Debreceni bőtermő	Kántor- jánosi 1	Újfehértói fürtös	Cigány-meggy 7	Open pollination
Pándy 7	4		0	0	6.0	17.6	13.9
Debreceni bőt.	3	4.5		8.4	8.6	1.0	19.5
Kántorjánosi 1	2	3.1	0			1.6	24.2
Újfehértói fürt.	2	0.9	0	2.3		4.4	21.1
Cigánymeggy 7	3	5.0	2.6	1.6	0		33.0

Table 7 Associations suggested for the sour cherry varieties improved and grown in Hungary

Relative order of harvest times of the varieties*	Groups of earliness	Varieties	Groups of blooming time	Character of fertility	Pollinizers suggested (as self-fertile varieties)
1	Early	Meteor korai Csengődi	medium early medium early	self-fertile	self-fertile
2					
3	Medium early	Érdi nagygyümölcs	medium early medium early	**self-sterile**	4, 11
4		Favorit		self-fertile	
5		Korai pipacsmeggy		self-fertile	
6	Medium late	Érdi jubileum	medium late	self-fertile	
7		Cigánymeggy 7	medium late	self-fertile	
8		Érdi bőtermő	early	self-fertile	
9		Maliga emléke	early	self-fertile	
10		Pándy 48 Cigánymeggy	early	**self-sterile**	2, 4, 11
11		C404	medium early	self-fertile	
12	late	Cigánymeggy 59	medium late	self-fertile	
13		Pándy C80	medium late	self-sterile	7, 12
14		Pándy 279	medium late	self-sterile	7, 12
15	very late	Debreceni bőtermő	late	self-fertile	
16		Kántorjánosi 3	late	self-fertile	
17		Újfehértói fürtös	late	self-fertile	

* Remark: the numbers in column 1 identify the variety in column 6

3.6. Association of varieties

The new Hungarian sour cherry varieties being sufficiently self-fertile, with few exceptions, may be planted in monovarietal blocks. No other varieties of foreign origin are needed as pollinizers, either. Earlier, there were also self-sterile *Cigánymeggy* varieties in the Hungarian orchard, but at present self-fertile varieties are multiplied and planted, only. The latters do not need pollinizers for the safety of yield. An additional cross fertilisation of those varieties in essentially undesirable as it may cause further reduction of fruit size by oversetting. Those few self-sterile Hungarian varieties commercially admitted (clones of *Pándy* and *Érdi nagygyümölcsű*) should be associated with pollinizer varieties, i.e. at least two different varieties are able to cover 70% of the blooming period necessary for reliable yields. In spite of the best association those varieties are poor yielders with irregular and low fruit set. The sole justification of their plantation depends on the exceptionally high prices offered on the market.

The self-fertile varieties, *Újfehértói fürtös*, *Kántorjánosi* and *Debreceni bőtermő* do not need to be planted in association with pollinizer varieties. Additional cross fertilisation may increase fruit set beyond the desired optimum causing reduction in fruit size. Those varieties are competitive on the market as long as their fruit diameter kept the standard of 21 mm, at least. Thus they may substitute the famous *Pándy* variety. Smaller fruits are not desirable in processing either because of their relatively large stones. The three varieties mentioned, being genetically related, are virtually inter-incompatible, thus their vicinity does not harm the quality. The effect of a sour cherry pollinizer on fruit set is not valid beyond the distance of 8 to 10 m (*Nyéki & Soltész* 1977). Suggestions concerning the reasonable combination of sour cherry varieties are presented in Table 7.

Discussion

Morphological and phenological characters of sour cherries studied are to be considered with different weight in exploring the genetic relations of varieties.

The majority of the results presented refers to three self-fertile varieties of the Pándy type, being highly similar to each other and to the standard variety *Pándy*.

Under the conditions of the observations lasting 13 years at two growing sites, the most useful characters proved to be the dates of blooming and ripening, the size of fruits and the fertility relations.

Experimental cross fertilisation prove the presence of sterility genes found in the self-sterile variety Pándy also in the varieties *Újfehértói fürtös*, *Debreceni bőtermő* and *Kántorjánosi*.

Data of leaf characters are of a single year, however, the low variability allowed the conclusion that *Pándy 279* and the allegedly relative three self-fertile varieties of the Pándy type are very similar. The present measurements corroborate earlier suppositions concerning the genetic relation of the varieties. The proofs presented are to be supplemented with isozyme analysis too.

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