Fruit Crops

Time of flowering and fertilisation of quince varieties

Szabó, T.[1], Nyéki, J.[2], Soltész, M.[3], Szabó, Z.[2] and Tóth, T.[3]

[1] *Fruit Research Station*
H–4244 Újfehértó, P.O. Box 38.
[2] *DATE, College of Agriculture*
H–5541 Szarvas, Szabadság u. 1–3.
[3] *KÉE, College of Horticulture*
H–6001 Kecskemét, Erdei F. tér 1.

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Summary: Literature dealing with flowering and fertilisation of quince is scarce. Most controversial and scanty are informations on observations of self- and cross-pollination. According to our observations, differences in blooming time are few (2–3) days only, thus flowering of most varieties is synchronous. The varieties observed are grouped as early, intermediate and late flowering ones. Self fertility of the individual varieties, however, was not assessed unequivocally, therefore it is recommended, by safety reasons, to consider quince actually as a whole to be auto-incompatible. Artificial self-pollination (or rather geitonogamy) as well as cross pollination with other varieties increased substantially fruit set if compared with the results of natural self-pollination (autogamy). According to the fruit set of their open pollinated flowers, varieties have been classified according to fertility as low (below 10 %), medium (between 10 and 20 %) and high (more than 20 %). Cross fertility of varieties is highly variable depending on combination and on season. Contradictory data are probably due to the sensitivity of quince to conditions of search. Better fruit set was coincident with higher number of stout seeds per fruit. Well developed seeds are definitely a prerequisite of larger fruit size.

Introduction

Research papers dealing with flowering and relations of pollination in quince varieties under conditions of Hungary are but few. Contradictory reports left open most of the important questions on the matter. Some quince varieties are dealt with in the present paper as for their blooming time and cross-pollinating relations, on the base of data available as well as raised experimentally.

The initiation of flower primordia in the buds of quince started at the beginning of September, or sometimes at the end of August according to *Angelov* (1975). Vigorous, long shoots differentiate flowers later by about one month than short ones. Thus flower differentiation ensues much later and slower than in apple and pear. They need in quince at least 6–7 months until being fully developed.

Quince flowers are produced singly in apical position of shoots started from mixed buds located on the last year's or earlier grown wood. Flowers appear at the shoots grown to a length of 4 to 10 cm on a very short peduncle, being almost sessile. The diameter of open flowers is about 5 cm as the petals are pretty large. The colour of petals varies between white and scarlet (mostly pink). In 5 carpels of the fruit as many as 50 seeds may develop. The carpels are fused at the base, only.

The flowering time of quince is relatively late, thus late frosts do no or rarely harm at blooming. According to the notes of *Brózik* (1980) the start of flowering in 23 varieties and clones of quince varied within the period of 1961 and 1966 between 20 April and 18 May.

Because of an effective cross pollination, the coincidence of flowering times in different varieties is important. According to *Maliga* (1966), the relative order of flowering of the varieties observed was the following: *Horváth birs, Bereczki birs,* then *Konstantinápolyi, Metzi, Portugál birs,* and as the latest, *Vranja.*

BRÓZIK (1980) distinguished the three groups of quince varieties

Early flowering	Intermediate flowering time	Late flowering
Alma alakú birs	Champion	Vranja
Bereczki	Metzi	Mammoth
Horváth birs	Leskováci óriás birs	Konstantinápolyi
	Portugál	
	Angersi	

Self fertility of quince is a matter of controversy in the literature. The only variety **Bereczki birs** has been judged by earlier authors, differently (according to *Nyéki,* 1990)

Author (year)	Ripe fruit obtained on selfed flowers in %
Kordon (1958)	8
Stancevic (1963)	12
Brózik (1964, unpublished)	19.3
Maliga (1966)	0 – 1.1
Ersov & Hrolikova (1970)	10 – 12.4
Angelov (1975)	0
Aeppli (1984)	1.1 – 15.9

In an attempt to find appropriate pollinisers for given varieties, very little information has been found. As a good pollen donor, the variety *Bereczki* was identified (*Duganova & Hrolikova,* 1977), then *Moldovanesti (Roman & Baja,* 1984). Inter-incompatibility was found in some combinations only – varieties involved were unimportant for Hungarian conditions.

Material and methods

In 1997 and 1998 eight quince varieties were observed at two growing sites for flowering time and pollinating relations. On the Research Station, Újfehértó, 6 varieties and in the orchard of the College of Horticulture, at Kecskemét, the varieties *Angersi* and *Bereczki*, whereas, at Gerő-major *Leskovacka* and *Vranja* were the objects of studies.

The time of flowering and the density of flowers has been determined by estimation:

start of flowering = first flowers open
main flowering = the most flowers are open
end of flowering = all flowers shed petals

Flower density is graded on a scale of 0 to 5:

0 = no flowers
5 = maximal flower density

In order to test the effect of autogamy, flowers were isolated by pergamin bags until the end of flowering, then set free. Before manual cross pollination the flowers were sculated, carefully.

Fruit set was decided by counting the set and ripe fruits. In the fruits the stout seeds were counted only.

Results

The time of flowering

As expected, flowering ensued late, after apples finished, on the end of April up to the beginning of May.

During the two years the difference between varieties concerning the start of the flowering period was 3 days at Újfehértó, only 1–2 days at Kecskemét. The main flowering was more different, i.e. 5 days at Újfehértó and 3 days at Kecskemét *(Table 1.).*

The varieties have been assigned to three categories according their flowering time:

early flowering	intermediate flowering	late flowering
Mezőtúri	Angersi Bereczki Bereczki bőtermő Champion Vranja	Konstantinápolyi Leskovacka

The two experimental years produced different data in all characters observed. The start of flowering was later in 1997 by 8–12 days than next year, but in main flowering time the difference was less. Late flowering meant shorter flowering period of all varieties. The length of the flowering period registered varied between 7–17 days, depending on season, growing site and variety.

The sequence of varieties considering their start as well the main flowering times did not change comparing the two years.

The grouping of varieties may show differences in relation to earlier Hungarian data *(Nyéki,* 1980). In exploring the data of flowering time and the relative sequence of varieties published earlier, we found similar deviations.

Quite a few, 23, quince varieties were observed by *Brózik* between 1961 and 1966. Flowering has been located to the interval between 20 April and 18 May. The start of flowering ranged 3–5 days, the main flowering 3–7 days regarding the different varieties. In case of seasons with earlier flowering, the differences between varieties increased.

Angelov (1975) observed 3–4 days between the start of flowering of varieties. The whole period of flowering lasted 6–20 days. The first flowers opened on the end of short shoots.

The relative sequence of varieties according to flowering time is according to *Maliga* (1966): *Horváth birs* followed by *Bereczki birs*, then *Konstantinápolyi, Metzi, Portugál birs*, and as the latest, *Vranja*. The main flowering time of the varieties studied did not differ from each other more than 1-2 days. According to him, the overlap of flowering periods is sufficient from the point of view of effective pollination.

The variety *Konstantinápolyi* produced flowers abundantly in both years. *Leskovacka* as well, but showed a strong tendency to alternation. The less flowers are produced by *Vranja.* The rest of varieties flowered regularly.

Self fertility

The literature concerning auto-fertility of quinces is controversial. Some growers consider quince as a self fertile species, whereas others claim to know self sterile varieties and partially self fertile ones as well. Even experts do not agree in that question. Single trees of home gardens yield well, however, monovarietal orchards (e.g. of cv. *Bereczki*) are unfruitful or very poor yielding.

One cannot avoid the question, what are the fertility relations of quince varieties grown in Hungary and how they should be associated in one plantation for achieving adequate yields (25–31 t/ha).

Table 1 – Blooming time of quince varieties (Újfehértó and Kecskemét, 1997-1998)

Variety	Site	Year	Start of blooming	Main full bloom	End of blooming	Length of bloomig Cdays	Flower density (0–5)
ANGERSI	Újfehértó	1997	May 11	May 13	May 19	9	3.75
		1998	April 30	May 04	May 10	11	4.75
	Kecskemét	1997	May 04	May 08	May 12	9	5.00
		1998	April 26.	May 01	May 09	14	4.00
BERECZKI	Újfehértó	1997	May 11	May 13	May 19	9	4.00
		1998	April 30	May 04	May 09	11	3.75
	Kecskemét	1997	May 04	May 08	May 12	9	5.00
		1998	April 26	May 01	May 09	14	4.00
BERECZKI BŐTERMŐ	Újfehértó	1997	May 11	May 13	May 19	9	4.00
		1998	April 30	May 04	May 09	10	4.00
CHAMPION	Újfehértó	1997	May 10	May 13	May 17	8	4.25
		1998	April 29	May 02	May 10	12	4.25
KONSTANTINÁPOLYI	Újfehértó	1997	May 12	May 14	May 18	7	5.00
		1998	April 30	May 05	May 10	11	5.00
LESKOVACKA	Kecskemét	1997	May 05	May 11	May 18	14	5.00
		1998	April 28	May 04	May 11	17	3.00
MEZŐTÚRI	Újfehértó	1997	May 09	May 11	May 15	7	4.75
		1998	April 28	April 30	May 05	8	5.00
VRANJA	Kecskemét	1997	May 04	May 09	May 14	11	3.00
		1998	April 17	May 03	May 12	16.	2.00

Table 2 – Fruit set in self pollinated and open pollinated quince varieties (Újfehértó, 1997–1998)

Variety	Year	Self fertility		Open pollination		
		Flowers isolated	Fruit set %	Flowers counted	Fruit set %	Number of seeds/fruit
ANGERSI	1997	87	0	184	13.6	27.1
	1998	83	0	253	17.0	12.4
BERECZKI	1997	96	0	171	17.5	5.6
	1998	71	0	182	6.0	5.3
BERECZKI BŐTERMŐ	1997	99	0	192	38.0	19.2
	1998	60	0	222	2.7	15.2
CHAMPION	1997	86	0	163	13.0	15.9
	1998	65	0	211	4.3	8.7
KONSTANTINÁPOLYI	1997	143	0	203	11.8	9.5
	1998	93	0	303	4.3	3.8
MEZŐTÚRI	1997	88	0	158	42.4	31.2
	1998	67	0	238	11.8	25.8

Table 3 – Self fertility and self- pollinating ability of quince varieties (Kecskemét, 1997–1998)

Variety	Year	Autogamy			Fruit mass (g)	Geitonogamy			Fruit mass (g)
		Flower isolated	Fruit set %	Seed content per fruit		Flowers pollinated	Fruit set %	Seed content per fruit	
ANGERSI	1997	124	1.6	1.6	165				
	1998	116	0.0	–					
BERECZKI	1997	92	4.3	1.2	195				
	1998	148	0.0	–					
LESKOVACKA	1997	189	0.0	–		135	11.0	25.0	115
	1998	286	1.0	21.0	206	144	17.0	17.8	147
VRANJA	1997	68	6.0	7.5	193	120	5.0	14.0	194
	1998	96	0.0	–		72	11.0	16.0	287

Literature and practical informations concluded to the statement that flower density is relatively low in quince compared with other fruit species (apple and pear), consequently, dependable yields require at least 20–25 % rate of fruit set.

Our own studies at Újfehértó resulted 0 % sets on autopollinated flowers of all varieties tested *(Table 2)*, though an infection of Monilia during the flowering period impaired fruit set, severely.

At Kecskemét, natural self pollination produced fruit but once during the two experimental years. The rate of fruit set at natural autogamy varied between 0.0 and 6.0 % *(Table 3)*.

Selfing by hand pollination succeded in both years on the varieties Leskovacka and Vranja. They set fruit at 11–17 % and 5–11 %, respectively.

The results suggest that in monovarietal plantations - at least of the varieties Leskovacka and Vranja - low or even poor yields are not due to auto-incompatibility but as a consequence of lacking agents or adverse weather in pollen transfer.

The two years' (1997, 1998) results obtained on 34 varieties support the idea conceived earlier that fruit set of quince is subject to environmental conditions, very much.

Free pollination

Fruit set in open pollinated flowers of quince varied widely depending on variety, season and growing site *(Tables 2 and 4)*. Results could rise in all varieties above 10 % and the maximum was registered in cv. Mezőtúri, 1997, with 42.4 %. Varieties are grouped according to their maximal fruit set observed on open pollinated flowers:

low rate of fruit set (below 10%)	intermediate fruit set (between 10 – 20 %)	high rate of fruit set (above 20 %)
Bereczki (Kecskemét)	Angersi Bereczki (Újfehértó) Champion Konstantinápolyi	Bereczki bőtermő Leskovacka Mezőtúri

Both growing sites produced higher rates of fruit set in 1997. Újfehértó as growing site was more favourable for fruit set in both seasons.

Yield of the trees is the result of three components: flower density, rate of fruit set and fruit size. The variety Vranja produces very large fruits, thus yields may attain an acceptable level in spite of its lower flower density and rate of fruit set, but it did not outyield Leskovacka in any of the years observed.

Cross fertilisation

It was stated by *Maliga* (1966) already that fruit set of cv. Bereczki was improved substantially by cross pollination in relation to self pollination.

At Újfehértó, the fruit set of 6 varieties were observed having been cross pollinated in a system of 30 combinations for both seasons 1997 and 1998. In 1997, 18, whereas in 1998, 22 combinations did not produce fruits at all *(Table 5 and 6)*. According to our supposition, the cause of low fertility was not inter-incompatibility of the varieties but the shedding of flowers due to the high infection rate of the Monilia fungus. The pergamin paper bag used for isolation was much favourable to the fungus. In 1998, flowers of the variety Angersi tolerated well the muslin bags and allowed very high rates of fruit set.

For the purpose to choose pollinator varieties, a rate of fruit set above 20 % as criterion should be observed, but unfortunately, in 1997, there was only one combination (Bereczki bőtermő x Champion), in 1998, two of them on the cv. Angersi, under muslin isolator. Therefore, rate of fruit set between 10–20 % was considered to be satisfactory, and below 10 % as poor.

At Kecskemét, 1997, the combination Leskovacka x Vranja, whereas in 1998, Vranja x Lesklovacka proved to be less fertile. Those varieties are inter-compatible but environmental conditions alter the rate of fruit set. Leskovacka set fruit abundantly after free pollination, even more than when hand pollinated with the pollen of Vranja. The reason of it is attributed to the much better chance and longer time of being pollinated by insects than once, under the bag, at the unique opportunity of hand pollination when the arbitrary conditions of temperature and humidity were most likely suboptimal for fruit set *(Table 7)*.

Conclusions to be drawn from the data obtained:

- contradictions among data in the literature are due to different environmental conditions of the objects observed, because the quince is utterly sensitive (e.g. the isolation by pergamin bags or muslin)
- fertility relations of varieties cannot be cleared but at different growing sites and during several seasons. Repeated observations are necessary during the same flowering season too.
- reliable fruit set is expected when flowering period is long enough that the stigmata may receive pollen more than once.
- in the present experiment, selfing and cross pollination has been performed at different times, that might have been one of the reasons of contradicting results. For the sake of maximal accuracy, experimental pollinations should be made synchronously, yearly, at similar conditions.

Seed content of the fruits

In all cross combinations, the seed content of fruits was checked, systematically. Seed number is, certainly, a variety character but it depends also on the conditions of fruit set. Present data suggest that a higher number of seeds is associated with a higher rate of fruit set. The highest number of seeds was found in crosspollinated fruits *(Table 8)*.

The seed content typical to a particular variety is to be found in fruits obtained by open pollination (in an environment saturated with compatible pollen). Many (more

Table 4 – Fruit set of open pollinated quince flowers and the fruit characters of the respective varieties (Kecskemét, 1997–1998)

Variety	Year	Number of flowers	Fruit set %	Fruit characters			
				mass (gram)	length (mm)	diameter (mm)	stout seed per fruit
Bereczki birs	1997	365	8.8	235.2	85.4	72.2	0.7
	1998	252	5.0	215.4	80.6	69.4	19.5
Angersi birs	1997	436	11.9	221.6	80.7	74.1	1.3
	1998	196	5.0	195.0	76.4	72.5	17.5
Leskovacka	1997	650	21.5	133.3	59.2	64.0	26.9
	1998	364	9.0	168.6	66.6	69.0	13.5
Vranja	1997	350	17.3	180.4	90.7	66.3	17.9
	1998	88	14.0	599.9	120.4	98.3	18.0

Table 5 – Fruit set (%) of quince varieties and seed content of fruits in different cross combinations (Újfehértó, 1997)

Male parent / Female parent	Angersi	Bereczki	Bereczki bőtermő	Champion	Konstanti -nápolyi	Mezőtúri	Mean fruit set
Angersi	2.2 8.0	0	0	2.0 26.0	2.1 27.0	0	1.05
Bereczki	0	0	0	0	0	0	0
Bereczki bőtermő	5.7 19.0	2.0 3.0	7.8 12.0	32.5 20.8	4.3 12.0	2.0 23.0	9.05
Champion	0	0	0	0	0	0	0
Konstantinápolyi	0	0	0	0	0	0	0
Mezőtúri	7.1 40.3	2.7 14.0	2.5 37.0	6.3 28.5	2.8 17.0	0	3.57
Mean fruit set	2.50	0.78	1.72		6.80	1.53	1.40

Remark: 2.2 = the final data of fruit set are introduced to the Table (%).
8.0 = the mean number of stout seeds per fruit are in the nominator.

Table 6 – Fruit set and the number of seeds per fruit depending on the polliniser, in quince varieties (Újfehértó, 1998)

Male parent / Female parent	Angersi	Bereczki	Bereczki bőtermő	Champion	Konstanti -nápolyi	Mezőtúri	Mean fruit set
Angersi	0	0	1.27 16.0	4.84 13.0	2.27 8.5	11.46 17.9	3.31
Bereczki	0	0	0	0	0	14.29 x x	2.38
Bereczki bőtermő	0	0	0	0	0	0	0
Champion	0	2.04 35.0	0	0	0	13.13 42.2	2.03
Konstantinápolyi	0	0	0	0	0	0	0
Mezőtúri	0	2.22 19.0	0	0	0	0	0.37
Mean fruit set	0	0.71	0.21	0.81	0.38	5.98	
Angersi (under muslin bag)	21.43 8.3	0	7.69 1.0	18.18 15.5	0	40.0 38.5	14.55

Remark: Fruit set after the physiological drop.
x = no data

21.43 = fruit set %
8.3 = mean number of stout seeds per fruit

Table 7 – Reciprocal fertilisation of the quince varieties Leskovacka and Vranja (Kecskemét, 1997 and 1998)

Year	Female parent	Male parent	Number emasculted of flowers pollinated	Fruit set %	Seed content of fruits	Fruit mass gram
1997	Leskovacka	Vranja	95	5.0	4.6	145.6
	Vranja	Leskovacka	130	21.0	3.0	300.0
1998	Leskovacka	Vranja	156	12.0	2.1	201.0
	Vranja	Leskovacka	84	4.0	8.0	315.0

Table 8 – Seed content of quince fruits depending on the source of pollination

Site	Year	Autogamy			Geitonogamy			Open pollination			Cross pollination		
		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
ÚJFEHÉRTÓ	1997	–	–	–	8.0	12.0	10.0	5.6	31.2	18.1	12.0	40.3	23.3
	1998	–	–	–	–	–	–	3.8	25.8	11.9	8.5	42.2	21.7
KECSKEMÉT	1997	1.2	7.5	3.4	14.0	25.0	19.5	0.7	26.9	11.7	3.0	4.5	3.8
	1998	–	–	21.0	16.0	17.8	16.9	13.5	19.5	17.1	2.1	8.0	5.1

than 20) seeds are found in cv. Mezőtúri fruits, whereas few (less than 10) in cv. Bereczki (at Újfehértó) and in Konstantinápolyi fruits. There was no close relation between the shape of fruit and its seed content, but it is a fact that in the years of large yields, fruit size is dependent on the number of seeds.

Association of varieties

In the planning of commercial quince plantations, it is an advisable rule to consider all quince varieties offered in Hungary, as self-incompatible. A mutual overlap in the main flowering periods of the associated varieties should be observed as a condition of adequate fruit set.

Mutually polliniser varieties should be chosen according to:

- their overlap of the main flowering periods,
- their mutual (reciprocal) compatibility as maternal or paternal parent,
- their coincident start of fructification,
- their value and acceptance on the market.

The varietal properties to be considered in the association of the varieties are explored by *Nyéki* (1980 and 1990) as well as by *Szabó* (1997 and 1998), moreover, a short summary is given in Table 9.

Table 9 – Varietal characters as for the association of quince varieties in plantations

Variety	Time of ripening	Flowering time group	Self fertility	Fertility at open pollination	Polliniser varieties recommended
ANGERSI	mid – end Sept.	intermediate	not clear	intermediate	BERECZKI BŐTERMŐ, CHAMPION, KONSTANTINÁPOLYI, MEZŐTÚRI
BERECZKI	end of Sept.	intermediate	not clear	poor	ANGERSI, CHAMPION, KONSTANTINÁPOLYI, VRANJA
BERECZKI BŐTERMŐ	end of Sept.	intermediate	not clear	high	ANGERSI, CHAMPION, KONSTANTINÁPOLYI, MEZŐTÚRI
CHAMPION	end of Sept.	intermediate	not clear	intermediate	ANGERSI, BERECZKI, KONSTANTINÁPOLYI, MEZŐTÚRI, VRANJA
KONSTANTINÁPOLYI	first part of Oct.	late	not clear	intermediate	ANGERSI, BERECZKI, BERECZKI BŐTERMŐ, CHAMPION, MEZŐTÚRI
LESKOVACKA		late	not clear	high	VRANJA
MEZŐTÚRI	first part of Oct.	early	not clear	high	ANGERSI, BERECZKI, CHAMPION, KONSTANTINÁPOLYI
VRANJA		intermediate	not clear	intermediate	LESKOVACKA

There is but little difference in the main flowering time of the varieties, therefore, the coincidence necessary for mutual pollination is acceptable. Self fertility of the varieties is still an open question. Varieties should be planted in alternate rows. For the sake of higher safety, some pollinisers could be scattered also within the rows. According to *Angelov* (1981) a reduced distance between trees within the rows has a beneficial effect on the yield of the trees.

The quince is an insect pollinated fruit species as well. Its flowers attract honey bees as well as bumble bees. In the five carpels of a flower there are at least 70 ovules ready to be fertilised, and they need more pollen than in apple and pear. Sufficient insect pollination is, however, provided by 1–2 hives per hectar.

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