Floral biology and fertility of apricot

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The time of flowering

Apricot is an early blooming species. In Hungary, depending on the season, the first flowers open between the end of February and the second part of April. According to *Nyújtó* (1980), as an average of many years, the interval of April 8 and 13 was characteristic, but during the last 10 years the dates shifted to be earlier by some 7 to 10 days *(Nyéki* et al., 1998, *Szabó & Nyéki,* 1991, *Szalay & Szabó* 1999). *Pedric* (1992) stated that the earliest blooming varieties started flowering between March 11 and April 7 *(Table 1).* In Hungary, during a longer period of years, the dates of the start of blooming in the same variety may vary as much as 40 days.

Table 1 The earliest and latest dates of start of blooming in 6 subsequent seasons (according to Pedryc, 1992)

Year	Start of earliest var.	Blooming latest var.	Difference (days)	Number of varieties
1986	Apr. 7	Apr. 11	4	254
1988	Apr. 2	Apr. 10	8	256
1989	March 24	Apr. 1	8	95
1990	March 11	March 21	10	114
1991	March 31	Apr. 8	8	154
1992	Apr. 1	Apr. 7	6	265

On the northern border of apricot cultivation, there is but little difference in blooming date of the varieties. Actually, the delay between earliest and latest varieties grown show 4–5 day differences between. A higher number varieties and cold spring weather may produce some difference of 8–12 days *(Nyújtó* 1980; *Pedric* 1992). The delay between the first and last blooming varieties depends on the date of the beginning of blooming. The earlier the date of start, the longer the delay between varieties

Within the variety group of *Magyar kajszi, Nyújtó* (1980) observed differences of 3 to 12 days in the start of flowering, whereas *Vachun* (1983) stated 1–3 day differences between clones of the *Velkopavlovicka* variety.

The influence of the growing site was observed every year *(Nyújtó* 1980) Blooming started, as a rule, 2–7 days ahead at Cegléd than at Érd. In the area of Gönc (NE Hungary), apricot flowering started some 7–10 days later than in the SW part of the country. However the difference was even 42 days in 1988, when at Letenye (SW) February 20 was the date, whereas away to NE about 110 km, at Siófok Febr. 28, further, in the NE end of Hungary at Gönc, April 3.

In countries of mild climate, the difference in flowering of varieties used to be much larger. *Della Strada* et al. (1989) reported that in Central Italy the early variety, *Mech Mech Precoce*, started blooming at February 15, whereas the *Stella* started at March 19.

The length of flowering period of apricot trees is also inversely related to the date when blooming started. As an extreme example, 5 days may elapse between the start and the end of booming *(Nyújtó 1980). Magyar kajszi* finished blooming within 6–7 days at 20°C, whereas 8–11 days at 15–20 °C, but 11–16 days at 12–17 °C (Surányi & Molnár 1981). Szalay & Szabó (1999) registered the blooming period of 20 apricot varieties. At high temperatures the period lasted 5 to 7 days, at cool weather 14 to 21 days. In *Figure 1*, sequence and duration of flowering in varieties is presented. The sequence of varieties may change according to the season.

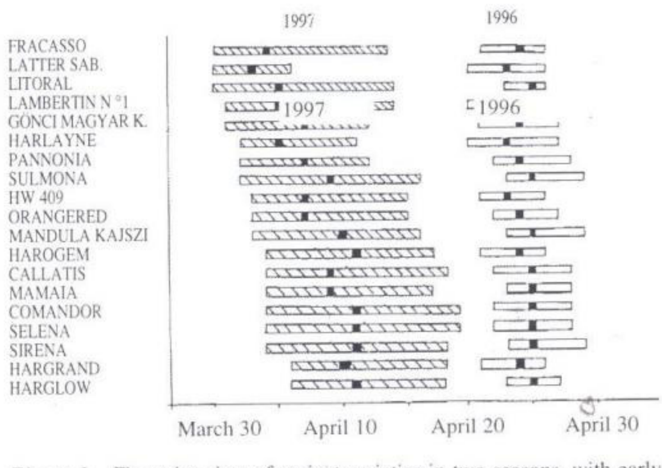

Figure 1 Flowering time of apricot varieties in two seasons, with early and late (1997, 1996 resp.) blooming dates (after *Szalay & Szabó,* 1999) (The black section means the full bloom period)

Blooming time groups of varieties

Pedric (1992) assigned varieties to groups according to a flowering index. The interval of differences in the beginning of the earliest and latest flowering variety was divided into four parts. The four groups received values of 0.25, 0.50, 0.75 and 1.00, respectively. The measurements have been repeated during several years, and the average of the numbers assigned to one variety has bean calculated. The early varieties received numbers lower than 0.375 whereas the late ones higher than 0.75.

Nyújtó (1980), *Szabó* & *Nyéki* (1992) and *Szalay* & *Szabó* (1999) took only three groups of varieties with different blooming times, because the differences were small: early, intermediate and late varieties.

On the other hand, *Della Strada* et al. (1989) distinguished as many as 5 groups of varieties according to flowering dates:

(1) early	beginning of blooming before February 21
(2) medium early	between February 22 and 28
(3) intermediate	between March 1 and 7
(4) medium late	between March 8 and 14
(5) late	after March 14

Information concerning blooming dates and length of periods are relevant in the selection of efficient polliniser varieties for the main varieties. In the northern region of apricot culture the blooming period of almost all varieties overlap each other sufficiently.

Kerek & *Nyújtó* (1998), however, distinguished also 5 groups of varieties in flowering time, as shown in *Table 3*.

Szalay & *Szabó* (1999) explored 7 main varieties and 20 polliniser ones and stated that an overlap of 60 to 100 % was a the rule. In the studies of *Della Strada* (1989) and *Pirazzini* (1987) the flowering periods of early and late varieties did not overlap at all.

For the sake of an efficient pollination, the main flowering periods (when more than 50% of the flowers are open) of the respective varieties should overlap each other. According to our studies *(Szabó & Nyéki* 1992) 70% overlap are considered to be sufficient. For the sake of security, the use of more than one polliniser variety is recommended by Lichou (1998, *Figure 2)* and also referred to by *Nyéki* & *Szabó* (1999).

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x    x    0    x    x    0    etc.      x    x    0    0    etc.
x    x    0    x    x    0    etc.      x    x    0    0    etc.
x    x    0    x    x    0    etc.      x    x    0    0    etc.
etc.                                    etc.

x    x    0    0    □    □    x    x    0    0    etc.
x    x    0    0    □    □    x    x    0    0    etc.
x    x    0    0    □    □    x    x    0    0    etc.
etc.

x    x    x    0    x    x    x    etc.   Explantion: X = self-incompatible or
x    □    x    0    x    □    x    etc.               partially self-inc. trees
x    x    x    0    x    x    x    etc.
x    x    x    0    x    x    x    etc.     0 and □ = polliniser trees of
x    □    x    0    x    □    x    etc.               different varieties
etc.
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Figure 2 Schemes of the association of varieties to provide pollinisers for self-incompatible apricots (According to Lichou, 1998)

Table 2 Fertility types of apricot varieties grown and promising in Western Europe, and in the USA (according to *Guerriero* & *Viti* 1997 and *Lichou* 1998)

Self-incompatible and partially self-incompatible varieties	
Aurora	Moniqui
Bergarouge	Nonno
Gluthagold	Orangered
Damas Quina	Priana
Early Blush	Primula
Flamingold	Rival
Goldbar	Rutswick
Goldcot	Sortilége
Goldrich	Stark Early Orange
Goldstrike	Stella
Harcot	Sundrop
Hargrand	Sunglo
HW 408	Sungold
Ivresse	Veecot
Lambertin No 1	Velvaglo
Laycot	Venturina
Self-fertile varieties	
Bebeco	Malice
Beliana	Mariem
Bergeron	Modesto
Bulida	Orangé de Provence
Cafona	Précoce de Tyrinthe
Canino	Rosé de Fournes
Colomer	Rouge de Rivesaltes
Comédie	Rouge de Roussillon
Fantasme	Rouget de Sernhac
Frénésie	Royal Roussillon
Gaterie	Screara
Héléna de Roussillon	Tardif de Tain
Luizet	Tom Cot

Self fertility

Apricot is as a member of the Prunus genus equipped with a self-incompatibility system of the gametophytic type. In both, pollen and pistil, the alleles of the "S" gene are acting by prohibiting the growth of the pollen tube in the conductive tissue if the same, recessive alleles met. The allele of self fertility is dominant over the incompatibility alleles allows the growth of pollen tubes down to the ovule, irrespectively what was the genotype of the partner *(Burgos* 1995).

The self incompatibility alleles are present in all the related species as *Prunus armeniaca* L., *P. sibirica* L., *P. mume* (Sieb.) *Sieb* & *Zucc.* and *P. dasycarpa* (Ehrh.) as well *(Lomakin* 1975).

Self fertility of apricot varieties belonging to different ecological-geographical groups are screened by several authors. According to *Guerriero* & *Bartolini* (1995) referring to several authors *(Kostina, Smykhov* and *Couranjou)* the majority of the European varieties is self fertile, however, most of the North-African, Near-Eastern, Central-Asian and Caucasian vartieties are self-incompatible.

The physiology of fertility relations of the apricot are not elaborated, sufficiently. In breeding of new varieties, adaptation and in planning of plantations, the question of self fertility become crucial.

All varieties if their fertility does not allow economical yields in mono-varietal plantations, should be considered as self-incompatible. The grade of self-fertility, however, allows some qualification. *Nyéki* (1989):

Entirely self-incompatible	0% fruit set,
Self-incompatible	0.1 1% fruit set,
Partially self-incompatible	1.1 10% fruit set,
Self-fertile	10.1 20% fruit set,
Highly self-fertile	above 20% fruit set.

Among apricot varieties all variants of the above groups are found. Fertility relations of important varieties grown in Western Europe and the USA are shown in *Table 2.* Similarly, apricots of the Hungarian assortment represent self-incompatible, partially self-fertile and self fertile varieties *(Table 3.)*.

The extent of self-fertility is subject to several moments. It is variable according to growing site and to season too. The comparison of two seasons may reveal multiple differences *(Table 4.)*. Obviously, open pollinated flowers of even highly self-fertile varieties set more fruit than by self pollination.

Open pollinated flowers exhibited always higher rates of fruit set than self pollinated ones. Fertility of *Ceglédi óriás*, a self-incompatible apricot variety, has been traced through

Table 3 Blooming dates of apricot varieties grown as well as potentially important in Hungary, and their fertility relations, and recommended pollinisers for the self-incompatible varieties (after *Kerek & Nyújtó*, 1998)

Variety	Blooming time	Self-fertility type	Polliniser recommended
Harmat	early	partially	
Korai piros	early	partially	Magyar kajszi
Korai zamatos	early	self-fertile	
Ceglédi Piroska	medium	self-sterile	Ceglédi bíborkajszi Magyar kajszi, Pannónia
Ceglédi óriás	early	self-sterile	Ceglédi bíborkajszi Magyar kajszi
Szegedi mammut	early	self-sterile	Ceglédi bíborkajszi Magyar kajszi
Harcot	early	self-sterile	
N.J.A.-1	early	self-sterile	
Magyar kajszi C.235	medium early	self-fertile	
Gönci magyar kajszi	medium early	self-fertile	
Ceglédi bíborkajszi	medium early	self-fertile	
Veecot	medium	self-sterile	
Ligeti óriás	medium	self-sterile	Ceglédi bíborkajszi Magyar kajszi
Polonais	medium		
Rakovszky	medium early	self-fertile	
Pannónia	medium	self-fertile	
Mandulakajszi	late	partially	Magyar kajszi
Ceglédi arany	late	self-fertile	
Roxana	medium	partially	Magyar kajszi
Bergeron	late	self-fertile	
Ceglédi kedves	medium late	self-fertile	
Rózsakajszi C.1406	late	self-fertile	
Budapest	medium	self-fertile	
Borsi-féle kései rózsa	late	self-fertile	
Sirena	late	partially	Mandulakajszi, Selena, Sulmona
Selena	late	partially	Mandulakajszi, Sirena

Table 4 Fruit set after self- and free pollination in apricot varieties (after *Szabó* et al., 1999)

Variety	Self fertility (%)			Free pollination (%)			Difference between free–self pollination (%)
	1993	1996	mean	1993	1996	mean	
Callatis	25.0	16.8	20.9	44.5	41.3	42.9	22.0
Comandor	9.0	5.4	7.2	54.0	15.9	35.0	27.8
Litoral	6.	1.5	4.1	41.2	20.8	31.0	26.9
Mamaia	19.0	9.4	14.2	34.1	29.2	31.6	17.4
Selena	13.1	1.4	7.2	31.4	21.7	26.6	19.4
Sirena	6.1	13.6	9.8	16.9	26.2	21.6	11.9
Sulmona	15.5	4.0	9.8	23.3	16.5	19.9	10.1
Baneasa 4/11	–	12.5	12.5	–	34.0	34.0	21.5
Marculesti 18/6	10.6	4.4	7.5	44.0	14.0	29.0	21.5
Marculesti 69/10	6.5	1.6	4.0	37.5	11.1	24.3	20.3
Venus	20.2	2.8	11.5	43.6	3.5	28.6	17.1
Mandulakajszi	5.3	7.9	6.6	10.5	20.2	15.4	8.8

Table 5 Fruit set in the variety *Ceglédi óriás* (after *Nyéki* et al., 1998)

Year	Self fertility (%)	Fruit set by open pollination (%)
1967		34.0
1969	0	16.0
1971	1.2	48.0
1973	0	25.3
1977	0	0
1978	0.1	3.3
1979	0	0
1980	2.0	23.8
1981	0.4	0.3
1984	0	3.9
1985	0.2	15.0
Mean over years	**0.4**	**11.2**

11 years *(Table 5.)*. By self pollination single fruits were set, only. Open pollination in the milieu of other varieties produced variable (0 to 48 %) fruit sets.

The effect of growing site was observed according to *Table 6.* The same varieties displayed much higher fruit set by self pollination in Rumania than in Hungary. Fruit set of open pollinated flowers varied to a lesser extent. It is concluded that self-fertility of varieties cannot be determined except through several years at different growing sites.

Table 6 Fruit set in apricot varieties under conditions of free and self pollination at two growing sites (after *Petre* et al., 1997 and *Szabó* et al., 1999)

Variety	Open pollination (%)		Self pollination (%)	
	Hungary	Rumania	Hungary	Rumania
Comandor	35.0	35.4	7.2	21.3
Litoral	31.0	16.9	4.1	8.0
Mamaia	31.6	20.1	14.2	1.3
Selena	26.6	35.9	7.2	21.4
Sirena	22.2	31.8	9.8	21.6
Sulmona	19.9	31.0	9.8	24.8
Venus	28.6	38.5	11.5	21.9
Mean	27.8	29.9	9.1	17.2

Geitonogamy is in the majority of cases more efficient, regarding fruit set, than autogamy. Varieties, really self-fertile, produce sometimes higher rate of fruit set by artificial self pollination than by open pollination *(Nyújtó* 1980).

Fruit set of open pollinated flowers

As a rule, the rate of fruit set by open pollination is higher than that obtained by natural self-pollination. The difference was, according to *Szabó* et al. (1998), between 8.8 and 22% for 12 varieties studied.

Fruit set by open pollination is more variable in apricots than in other stone fruit species. The most decisive factor is the weather during the blooming time. A scale of varieties according to their fruit set under conditions of open pollination has been established by *Nyéki* (1989):

Low	above 10% fruit set,
Intermediate	between 10.0 and 20 %,
High	between 20.1 and 30 %,
Very high	above 30%.

Fruit set of apricots may reach very high values too:

Nyújtó (1980)	96.1%
Petre et al. (1997)	42.6%
Cociu (1993)	50.2%
Szabó et al. (1998)	54.0%

Nyéki (1989) presents the distribution of 27 varieties studied according to their fruit set under conditions of open pollination:

Very high	2%
High	17%
Intermediate	48%
Low	33%

Experiences allow the statement *(Nyújtó* 1980, *Szabó* & *Nyéki* 1992) that self-fertile varieties tend to set more even under conditions of open pollination than self-incompatible varieties.

Cross pollination

Relevant literature on that phenomenon in apricots is rather scarce. The varieites studied also by *Schultz* (1948) produced the data given in *Table 7*. The variation of the rate in fruit set was large (between 0 and 61%). Self-incompatible varieties, as *Riland* and *Perfection*, proved to be efficient pollinisers for other varieties. Self-fertile varieties

Table 7 Fruit set (%) in apricot varieties obtained by cross pollination (after *Schultz*, 1948)

Polliniser / Femal parent	Perfection	Riland	Bleinheim	Royal	Tilton	Wenatchee Moorpark	Female fertility
Perfection	2.0	25.6	3.1	15.3	7.1	10.3	12.3
Riland	22.7	0.0	0.4	14.5	4.0	4.8	9.3
Bleinheim	13.1	26.1	18.3	–	14.7	11.6	16.6
Royal	31.1	–	–	37.6	–	30.4	30.8
Tilton	28.0	24.1	17.0	10.0	22.9	0	15.8
Wenatchee Moorpark	40.0	4.8	7.4	26.4	11.2	22.5	18.0
Pollinising ability	**27.1**	**20.2**	**7.0**	**16.6**	**9.3**	**14.3**	

in some combinations, however, did not fertilise other varieties. The best pollinisers of the variety *Perfection* proved to be *Riland* and *Royal*. *Riland*, in turn, was fertilised well by Perfection and Royal.

Pirazzini (1997) attempted crosses between new varieties during three seasons. There too, seasons and combinations produced wide variations (0-73%) in fruit set. Suitable pollinisers may produce more than 50% fruit set on some varieties.

Inter-incompatibility

The occurrence of inter-incompatibility among stone fruits was stated mainly in sweet cherry and observed also in plum and sour cherry. In apricots, inter-incompatibility was first recognised since the beginning of the 1990-es. The genetic basis used in breeding was relatively narrow, moreover, the use also self-incompatible parents was, and will be in the future, the reason of the appearance of inter-incompatibility.

The first group of inter-incompatible varieties was reported by *Szabó* & *Nyéki* (1992): *Ceglédi óriás, Ligeti óriás, Nagykőrösi óriás, Szegedi mamut*. The mutual inter-incompatibility in the group of the "óriás" varieties is demonstrated in *Table 8*. In the same year appeared the paper of *Egea* et al. (1991), referring to the varieties *Moniqui Fino* and *Moniqui Borde*. *Egea* & *Burgos* (1996) analysed the inter-incompatibility between three North-American apricot varieties: *Hargrand, Goldrich* and *Lambertin No 1*. Among the parental varieties of those, however, we can detect the self-incompatible Perfection. Results of cross pollinations are presented in *Table 9*. In compatible combinations, a fruit set of 19 and 74% was found, whereas inter-incompatibility allowed less than 2% only. In inter-incompatible combinations pollen tubes did not reach the ovule in the pistils.

Table 8 Fruit set of "óriás" (giant type*) apricot varieties in different cross combinations (after *Nyéki* & *Szabó*, 1995)

Polliniser / Female parent	Year	Ceglédi óriás*	Nagykőrösi óriás*	Szegedi mammut*	Gönci magyar kajszi	Free pollination
Ceglédi óriás*	1989		0	0	62.2	19.4
	1990		0	1.5	2.2	6.3
	1991		0			5.2
Nagykőrösi óriás*	1989	0		1.4	0	
	1990	0.1		0	2.9	11.6
	1991	0				10.9
Szegedi mammut*	1989	0	0			
	1990	0	0		3.2	5.0
Gönci magyar kajszi	1980	14.6	10.7	37.3		47.4

Table 9 Fruit set in cross pollinated apricota varieties (after *Egea* & *Burgos*, 1996)

Polliniser / Femal parent	Lambertin No 1	Hargrand	Harcot	Goldrich
Lambertin No 1	1.7	1.9	73.7	0
Hargrand	0	0	19	0
Harcot	65.9	36.7	0	62.5
Goldrich	–	–	–	0

Sterility

Pollen production of apricot flowers varied according to variety and season. Single anthers produce grains between 500 and 5950 *(Benedek* et al. 1991), or 4000 and 8000 *(Viti & Monteleone* 1991). Anomalies in development and defective grains are frequent in pollen in all varieties. Their frequency may represent 1 to 54% of the grains *(Vachun* 1981).

Partial and complete male sterility may result from genetic as well as from environmental or even pathological reasons. Degeneration ensues mainly in the stage of microspores, thus empty grains are released *(Guerriero & Bartolini* 1995). *Nakanashi* (1982) described male sterility in *Prunus mume*, a related species. *Madeira* et al. (1992) observed male sterility in the variety *CNEFFC*, where the abnormality was alleged to be a consequence of mycoplasm infection.

Pollen tube growth of the grains is equally variable, although the viability was in the majority of varieties sufficient *(Surányi* 1995). The size of the organs in the flower, i.e. the length of the pistil and the number of stamina is positively correlated with the ability of grains to produce a tube *(Surányi & Molnár* 1981). Warming up of the weather during the phase of dormancy causes less stamina and less pollen grains per anther, parallelly with a reduction of the ability of producing a tube *(Rjadnova* 1960). The latter faculty of the pollen is rather unstable and subject to variety and to the method of culturing, with extreme values of 3 to 83% according to *Forlani & Rotundo* (1977), or 20.9 to 76.5% according to *Mahanoglu* et al. (1995).

Defective pistils are more or less found in all varieties. *Maliga* (1948) distinguished 7 types of pistils *(Figure 3)*. Flowers with underdeveloped pistils are unable to set any fruit. According to him, sterile flowers occurred at a rate of 0 to 65% on trees of different varieties studied. Lichou et al. (1995), however, found in his studies 8 to 10 % sterile flowers. *Benedek* et al. (1991), in turn, treated 5 categories in the size of pistils. The number 1 group of flowers did not develop a pistil at all, in number 2 the pistil was very small. The rate of those two reached 70%, seasonally, in the *Screara, Farmingdale* and *Mandulakajszi* varieties. *Surányi & Molnár* (1981) stated that *Nancy, Early Golden, Marculesti 1, Paviot, Ceglédi biborkajszi, Mandulakajszi* and some Central Asian varieties are particularly inclined to produce that anomaly of defective pistils.

Quarta & Brunialti (1984) stated that the seasonal and vatietal variance of the rate of defective pistils is considerable, although there is no correlation with the actual rate of fruit set.

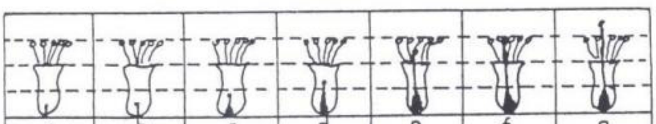

Figure 3 Types of pistils occurring in apricot flowers (Maliga, 1948)

Association of varieties suggested for plantations

Many self-incompatible and partially self-fertile varieties are grown in the practice. Their yield is dependent on the presence of adequate polliniser varieties.

At the selection of pollinisers some criteria should be observed as suggested by *Soltész* (1996). The overlap of blooming periods of the respective varieties, i.e. main variety and its polliniser, should be 70% at least. Blooming dynamics of apricots is concentrated and relatively short under continental conditions of Hungary. According to *Szalay & Szabó* (1999), a 60% overlap was general in almost all variety combinations, thus any random couple of varieties taken from neighbouring blooming time groups would exhaust criteria required.

The rate of overlap in blooming and the rate recommended for the polliniser trees are inversely correlated. A perfect (100%) overlap may justify a rate of association as 1:10, whereas the less overlap should be compensated by a higher rate of polliniser trees to be associated or more than one variety should be applied as polliniser.

The use of two pollinisers is encouraged by choosing one with earlier (1 or 2 days) and the other with later blooming date. Thus a continuous availability of compatible pollen is secured.

The varieties of different geographic regions are intercompatible with high probability *(McLaren* et al. 1995), thus the blooming dates are to be considered, only. There are, however, cases of inter-incompatibility described recently within a group of common ancestry *(Szabó & Nyéki* 1991, *Egea & Burgos* 1996), consequently, inter-fertility of varieties should be checked before the planning of associations.

Cross pollination increases fruit set even in self-fertile varieties, but the influence of different pollinizers could not be distinguished *(Mahanoglu* et al. 1995). At reliable growing conditions, however, some limitation of fruit set, or in other words, prevention of "oversetting" may be preferred for self-fertile varieties, thus monovarietal blocks are suggested in large plantations too. On the contrary, poor growing site and the risk of adverse weather conditions justify the combination of self-fertile varieties too.

The fruit set of a self-incompatible variety may drop drastically with the increasing distance from the polliniser trees *(McLaren* et al. 1995, *Nyéki* et al. 1995). The significance of distance is especially pronounced in seasons of unfavourable spring weather. In a large block of the variety *Ceglédi óriás* much more fruit per tree was set on the side near to a polliniser variety than on the opposite side *(Nyéki & Szabó* 1999). The recommended distance of the polliniser should be less than 20 or 25 metre *(Soltész* 1986).

According to the recommendations of *Nyújtó* (1980), self-incompatible varieties should be planted in single rows, only, partially self-fertile ones in 2–3-rows, whereas self-fertility allows (monovarietal) blocks of 6–8-rows, furthermore, the rows should not be interrupted by polliniser, and the final ratio of trees belonging to different varieties should be 1:1, 1:2, 1:3 or 1:1:1.

In favour to facilitate efficient operations (harvest, phytosanitary treatments, pruning), it is advisable to group trees of a single variety into two adjacent rows, at least, being conform with all possible fertility types of varieties. *Lichou* (1998) presented suggestions for the placement of varieties *(Table 3)*.

Unanswered questions and research objectives

In spite of several papers dealing with the floral biology and fertility of apricot, there is plenty of unsolved problems too.

Cleistogamy or bursting anthers and pollination within the unopened flower buds may occur depending largely on variety and weather conditions. A detailed study of the phenomenon is still desirable.

Among cultivated varieties there are several (and their number still tended to increase) self-incompatible ones. The check of the nature of fertility, especially the extent of partial self-fertility should precede the spread of each variety in commercial plantations.

Self-incompatible and partially self-compatible varieties need to be associated with efficient alternative pollinisers adaptable to variable markets and consumers preferences.

Inter-incompatible varieties are known but few as yet *(Szabó & Nyéki* 1991). In breeding of new varieties using also self-incompatible parents, new inter-incompatible combinations or even groups are expected to appear. The locus or DNA sequence of the incompatibility reaction should be identified and marked by biochemical or molecular methods.

The right way of associating varieties deserves more consideration. Self-incompatible and partially self-incompatible varieties need absolutely polliniser varieties of adequate quality. In adverse growing sites with a risk of winter- and spring-frosts, association of even self-fertile varieties would be beneficial in order to compensate for poor conditions of flowering and pollination.

A detailed analysis of meteorological phenomena being involved in the seasonal variation of fruit set is badly needed in order to develop methods of regulating fertility for the sake of optimal yield and quality.

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