

Association of European plum varieties in the orchards

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Summary: The flowering phenology, blooming time and inter-fertility relations of 63 European plum varieties has been studied at growing sites with different ecological conditions during a 10 year long period. The purpose was to develop a system of variety combinations which approaches an optimum in fertility as long as inter-fertility relations will cease to be a limiting factor of yield. According to their blooming time, varieties are assigned to 5 groups: very early, early, medium, late and very late. As for their fertility relations, four groups are formed: self-sterile (0%), partially self-fertile (0.1 to 10 %), self-fertile (10.1 to 20 %) and highly self-fertile (more than 20 % fruit set with self pollination). The four categories of fruit set at free pollination are also relevant to the grower: low (less than 10 %), medium (10 to 20 %), high (20 to 40 %) and very high (more than 40 % fruit set).

By artificial cross pollination, one combination Čačanska najbolja x Stanley proved to be mutually inter-incompatible. Blocks planted to a single self-sterile variety flanking a pollinizer variety proved the spacial distribution of the pollen. The reduction in fruit set was already apparent in the second row away from the pollinizer trees. In a large plantation, without bee hives, relatively low yield was stated on self-sterile trees even close to the pollinizer.

In the case of self-sterile and partially self-fertile varieties, a combination of three varieties is recommended. The blooming period of the pollinizer variety should overlap the period of the self-sterile variety at least by 70 %, and the distance should not exceed 15 to 20 meters. Association of self-fertile varieties may also enhance the productivity of the trees. In that case an overlap of 50 % in blooming time and a maximum distance between the varieties of 30 to 40 meters will be sufficient.

Introduction

In the assortment of European plums (*Prunus domestica* L.) all possible variants between self-sterility and self-fertility are represented which are, certainly, due to the hexaploid conditions of the chromosome number (Levickaya and Kotoman, 1980). Moreover, some male sterile plum varieties (e.g. Tuleu Gras, Centenar, Pescarus) are also grown. Self-sterile and partially self-fertile varieties are to be associated with pollinizer varieties in order to expect reasonable yields.

For the purpose of designing an efficacious association both, blooming periods and fertility relations of the varieties in question should be considered. Relevant details are treated by Tóth (1957), Szabó (1989), Szabó and Nyéki (1989), Nyéki and Szabó (1995), Szabó and Nyéki (1995). Bee pollination in Hungary was studied by Szabó et al (1989). Literature dealing with blooming and fertility relations of fruit trees of the moderate climate, plums included, was reviewed by Nyéki and Soltész (1996).

Material and methods

Blooming, self- and open pollination of European plum varieties has been studied during 2 to 9 years on as many as 63 varieties.

Our examinations concerning flowering dynamics were performed on 200 to 500 flowers per cultivar distributed on the four sections of the canopy. Blooming was traced daily from the beginning of the flowering period by recording the number of flowers in balloon stage, open flowers and blown flowers on a marked branch. On the basis of those records the following data are raised: the beginning of bloom (when the first flower opened), the time of full bloom (when the rate of open flowers has reached 50 %), the date of full bloom (when the rate of open flowers has reached its maximum), the end of bloom (when all flowers were blown).

Self pollination was studied on 20 to 30 cm long twigs which were covered with parchment paper bags when flowers were still in the balloon stage. Each time, 5 to 10 bags per cultivar were used to cage a total of 100 to 400 flowers. Bags were removed 3 to 4 days after petal fall.

Open pollination was observed on 200 to 500 flowers on 5 to 10 twigs per cultivar marked at a high of 1.5 to 2 m above the ground.

Cross pollination was recorded on self fertile varieties directly after emasculation. Pollinated flowers were caged by 5 to 10 parchment paper bags, and for a total of 100 to 400 flowers in each combination.

Flowers of self-sterile cultivars were also bagged in the balloon stage and pollinated in full bloom. After petal fall, bags were removed.

Fruit set was evaluated prior to ripening.

Plum varieties were classified into 5 or 4 groups defined by Nyéki (1989):

Self-fertility groups:

- ☉ Completely self-sterile: fruit set of 0 %,
- Self-sterile: fruit set between 0.1 and 1 %,
- Partially self-fertile: fruit set of 1.1 to 10 %,
- Self-fertile: fruit set between 10.1 and 20 %,
- Highly self-fertile: fruit set over 20 %.

Fruit set groups after open pollination:

- Low: fruit set lower than 10 %,
- Medium: fruit set between 10.1 and 20 %,
- High: fruit set between 20.1 and 40 %,
- Very high: fruit set over 40 %.

Results

1. Blooming time

The sequence of blooming time of the varieties changed yearly and also according to the growing site. The relative beginning of bloom and the date of full bloom of early blooming plum varieties varied by a 2 to 4 day interval whereas at the late blooming varieties by 1 to 2 days.

The start of blooming was related to the date of the *Stanley* variety, thus varieties are grouped according to *Table 1*. Out of the 63 varieties 18 % are rated as early blooming, 20.6 % as medium early, 17.5 as mid time, 19 % as medium late, and 23.5 % as late blooming. On the average of years, the earliest blooming variety started blooming 5 days before *Stanley*, the latest one 3 days after *Stanley*.

As the blooming period of self-sterile varieties should overlap that of the selected pollinizer variety by 70 % at least (Nyéki and Soltész, 1996), it is advisable to associate varieties of the same group of blooming time or they should belong to neighbouring groups.

2. Fertilisation

The ability of self-fertilisation as well as that of setting fruit by open pollination are genetically determined, i.e. they are characteristic to the respective variety but they are also modified by the growing site and by the particular season, substantially.

Self-fertility could produce 43 % fruit set at most, whereas the maximum fruit set by open pollination was 81 %.

Purposeful pollination of self-fertile varieties with the pollen of their own (geitonogamy) doubled the rate of fruit set as a mean in relation to the caged and unpollinated flowers.

Self-fertile varieties set fruit at a higher rate even by open pollination than self-sterile ones, therefore, the reliability of their yield is always better.

According to their rate of self-fertilisation the varieties are assigned to 5 distinct groups. Out of the 56 plum varieties 28.6 % was entirely self-sterile, 14.3 % self-sterile, 25 % partially self-fertile, 21.4 % self-fertile and 10.7 % was highly self-fertile.

According to the rate of fruit set by open pollination there are 4 groups. Out of 56 varieties 8.9 % set fruit at a low rate, 21.4 % at a medium rate, 59 % at a high rate and 10.7 % at a very high rate.

Experimental cross pollinations proved the fact that the rate of fruit set depends first of all on the genuine ability of the maternal variety. There was one combination, *Čačanska najbolja* x *Stanley*, being mutually inter-incompatible as the rate of fruit set did not attain 5 %.

3. Association recommended

Individual self-sterile plum varieties have been associated with adequate pollinizers according to their blooming time and ability of fertilisation (*Table 2*). For most self-sterile European plum varieties there are generally good pollinizers the following varieties: *Bluefre*, *Čačanska*

Table 1 Flowering and fertility groups of plum varieties

Varieties time according to their flowering	Flowering group	Self-fertility group	Fruit set groups after open pollination
Utility	early	self-sterile	medium
Bourdett Angelina	early	completely self-sterile	high
Silvia	early	completely self-sterile	high
Ontario	early	highly self-fertile	very high
Reine-Claude de Bavay	early	partially self-fertile	medium
Volosko	early	completely self-sterile	medium
Zimmer Frühzwetsche	early	self-sterile	high
President	early	completely self-sterile	high
Growers Late Victoria	early	partially self-fertile	high
Early Laxton	early	self-sterile	medium
Debreceeni muskotály	early	self-sterile	high
Czar	early	partially self-fertile	medium
Bartschis Frühzwetsche	early	completely self-sterile	high
Althanova Ringlota	early	completely self-sterile	medium
Ersinger Frühzwetsche	early	self-fertile	high
Opal	early	not studied	not studied
Sentyabrskaya	early	male sterile	medium
Cambridge Gage	early	self-sterile	high
Čačanska lepotica	early	partially self-fertile	medium
Čačanska najbolja	early	completely self-sterile	medium
Victoria	early	self-fertile	very high

Varieties time according to their flowering	Flowering group	Self-fertility group	Fruit set groups after open pollination
Ruth Gerstäter	early	not studied	low
Krikon	early	self-fertile	high
Čačanska rodna	early	highly self-fertile	very high
Čačanska II/II/80/59	early	completely self-sterile	not studied
Centenar	medium	male sterile	not studied
Löhr Pflaume	medium	self-fertile	very high
Italian Plum	medium	self-fertile	high
Valor	medium	completely self-sterile	high
Pescarus	medium	male sterile	low
Gras ameliorat	medium	not studied	high
Bluefre	medium	partially self-fertile	medium
Szopernyica	medium	self-fertile	high
Early Italian	medium	self-fertile	high
Alvena	medium	not studied	not studied
Kisinevskaya rannaya	medium	self-sterile	low
Richards Early Italian	medium late	self-fertile	high
Schwabs Frühzwetsche	medium late	self-fertile	high
Tuleu dulce	medium late	completely self-sterile	high
Fellenberg T. 24	medium late	self-fertile	high
Laxton blau	medium late	completely self-sterile	high
California blue	medium late	partially self-fertile	low
Chrudiemer	medium late	partially self-fertile	high
Albatros	medium late	male sterile	high
Stanley	medium late	partially self-fertile	high
Ageni	medium late	partially self-fertile	high
Frühe Fellenberger	medium late	not studied	not studied
Tuleu Timpuriu	medium late	male sterile	low
Besztercei Bt. 2	late	highly self-fertile	high
Korai Besztercei	late	self-fertile	high
Besztercei Bt. 1	late	partially self-fertile	high
Tuleu gras	late	male sterile	high
Asatan	late	self-sterile	medium
Besztercei Nn. 122	late	highly self-fertile	very high
Pozegaca	late	highly self-fertile	high
Pacific	late	completely self-sterile	high
Besztercei Bb 416	late	partially self-fertile	high
Myrabelle de Nancy	late	highly self-fertile	very high
Hauszwetsche Rudin	late	self-fertile	high
Hauszwetsche Grider	late	partially self-fertile	high
Vinatte Romanesti	late	not studied	not studied
Hauszwetsche T.F.	late	partially self-fertile	high
Besztercei szilva	late	not studied	not studied

Table 2 European plum varieties and their recommended pollinizers

Variety to be pollinated	Original observations as on good pollinizers	Recommended in the literature as pollinizer
Self-sterile varieties		
Altanova ringlota	Čačanska najbolja, Čačanska rodna	Ageni, Besztercei szilva, Stanley
Čačanska najbolja	Bluefre, lepotica, Čačanska rodna	Ruth Gerstäter, Stanley
Centenar	Bluefre, Čačanska lepotica, Stanley	Althanova ringlota, Ruth Gerstäter, Silvia, Stanley Ageni, President Stanley
Debreceni muskotály		
Pescarus		
President	Bluefre, Čačanska lepotica, Čačanska najbolja, Čačanska rodna	Althanova ringlota, Bluefre, Debreceni muskotály, Ruth Gerstäter, Stanley Ageni, Althanova ringlota, President, Silvia, Stanley
Ruth Gerstäter		Althanova ringlota, Bluefre, Stanley
Silvia	Čačanska lepotica, President	Ageni, Althanova ringlota, Bluefre, President, Ruth Gerstäter, Stanley
Tuleu gras		
Partially self-fertile varieties		
Bluefre	Besztercei szilva, President, Stanley	President, Ruth Gerstäter, Stanley
Čačanska lepotica		Čačanska najbolja, Čačanska rana
Stanley	Besztercei szilva, Bluefre	Bluefre, President, Ruth Gerstäter

lepotica, *Čačanska najbolja*, *Čačanska rodna* and *Stanley*. For early blooming varieties the variety *President* whereas for the late blooming ones *Besztercei* and *Stanley* are recommended.

Male sterile varieties should be associated with highly self-fertile and regularly yielding varieties. For *Centenar* we recommend *Čačanska rodna*, for *Pescarus* and *Tuleu gras*, in turn, *Čačanska rodna* and *Besztercei*.

Self-sterile varieties could be associated with each other as far as their blooming time is coincident at 70 % at least, but a mixed planting of 3 to 4 self-sterile varieties still may increase the security of yield.

Varieties with low self-fertility (*Bluefre*, *Čačanska lepotica*, *Stanley*) should not be planted in larger blocks than 20 to 40 m in diameter. The self-fertile varieties with very high and regular fruit set are preferably planted into pure stands as the very dense fruit load as a consequence of "oversetting" by cross pollination may lower the fruit size or quality.

Male sterile and self-sterile trees should be provided with pollinizers within a distance of 10 to 15 m. According to our observations, yield reduction on the trees is evident in the second row away from the pollinizer trees. At the same time, low fruit set (1 to 2 %) was observed in a 12-row block of *Čačanska najbolja* even in the marginal rows close to the pollinizers. The phenomenon was explained with the lack of insects as potential pollen vectors.

References

- Levitskaya, L.L. and Kotoman, C.M., 1980. Self-fruitfulness of several plum varieties. (in Russian) Sadov. Vinogr. Moldov. 7: 21–24.
- Nyéki J., 1989. Flowering and fertility in stone fruits (in Hungarian) D.Sc. thesis, MTA, Budapest
- Nyéki J. and Soltész M. (Eds), 1996. Floral biology of temperate zone fruit trees and small fruits. Akadémiai Kiadó, Budapest
- Nyéki J. and Szabó Z., 1995. Fruit set of plum cultivars under Hungarian ecological conditions. Acta Horticulturae 423: 185–191.
- Szabó Z. and Nyéki J., 1989. Selection of pollinating plum varieties and their placement in the orchard. Acta Agronomica Hungarica 38(3-4): 313–329.
- Szabó Z. and Nyéki J., 1995. Flowering phenology of plum cultivars under Hungarian ecological conditions. Acta Horticulturae 423: 23–29.
- Szabó Z., Nyéki J. and Benedek P., 1989. Behaviour of honeybees on plum trees and their role in the pollination and fruit set (in Hungarian). Kertgazdaság 21(1): 53–70.
- Tóth E., 1957. Physiological and morphological studies on plum varieties (in Hungarian). Kertészeti Kutató Int. Évkönyve 2: 11–129.