The effect of the fruit set on the mean mass of sour cherry fruits

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Summary: Experiments were conducted with four sour cherry cultivars three of that were self-fertile and one was self-sterile. Different levels of fruit set were obtained by limiting the bee pollination period. The limitation of the duration of the effective bee pollination period definitely affected the fruit set of all the four cvs. The mass of individual fruits seemed to be related to the final set but this relationship has not find to be definitely expressed statistically at that moderate level of maximum fruit sets (10–14 per cent at the maximum) we obtained in the experiments. For this reason, further research is needed to explore that level of fruit set that can notably reduce the fruit size (mass) to an undesirable extent.

Introduction

It has been well demonstrated that both self sterile and self fertile sour cherry cultivars need insect (bee) pollination to set an economic yield (*Benedek & Nyéki* 1995, 1996a, *Benedek, Nyéki & Szabó* 1990, *Benedek* et al. 2000). This is because even self-fertile sour cherries need some pollinating agents to carry viable pollen from the anthers to the stigmas of the flowers (*McGregor* 1976). Automatic self-pollination is prevented by the fact that the maturation of male and female reproductive organs does not overlap in sweet cherry flowers. Namely, anther dehiscence takes place much earlier prior to the maturation of the stigma. The pollen grains are sticky, like at all entomophilous plant species, and so wind fails to play any countable role in the pollination of their flowers (c.f. *Free* 1993) and, what is more, bees can collect the pollen from the dehisced anthers of the flowers in a short time prior to the stigma becomes receptive in the same flower.

Sour cherry is known to be fairly attractive to honeybees for the high sugar concentration of its nectar (*Benedek & Nyéki* 1997) and so intense bee visitation can result in a high fruit set. Heavy set, however, is usually believed to cause smaller fruit size. In the case of apple – that is a multi-seeded fruit species – more intense bee pollination can increase the number of viable seeds per fruit and this can prevent the fruit size (weight) to decrease, at least at the branch level (*Benedek & Nyéki* 1996b). Sour cherry fruits, however, contain a single seed only; consequently the compensation capacity of more intense bee pollination to fruit size (mass) is questionable. *Griggs* (1970), therefore, expressed the opinion, that heavy set at self-fertile sweet cherry cultivars may be undesirable for the reduced fruit size. This statement, however, is based on practical experiences only but no experimental verification is available and the critical level of fruit set at which the mass of fruits decreases greatly is unknown yet. Accordingly, an experiment were made to inspect the effect of fruit set to the mass of individual fruits of selected sour cherry cultivars.

Material and methods

The experiment was carried out at the experimental sour cherry plantation of the Fruit Research Station Ujfehértó (North-Eastern Hungary) in 1998. The experimental plantation contained trees of a number of cultivars. The trees were some 15–18 years old. The area was flat and the sour cherry plantation was 20 ha in size. Two bee colonies per hectare were placed at the experimental plantation just as the flowering has begun.

Four cultivars were selected for the research, three of them (*Ujfehértói fürtös, Kántorjánosi, Debreceni bőtermő)* were self-fertile and the fourth one was a self-sterile variety (*Pándy 279*).

Two trees were selected of each of the four cultivars. Branches bearing some 50 flowers were selected at the Northern and the Southern side of the trees. Treatments were applied on the selected branches both sides of each tree to achieve different levels of fruit set by limiting the effective duration of the insect (bee) pollination period. Five treatments were applied in four replicates per cultivar (at two branches per trees) as follows: 1=0% open (caged to exclude bees all along the blooming period), 2=35% open (caged from the commencement of the flowering and free pollination by the last third of the blooming period), 3=50% open first (free pollination at the first half of the blooming period and caged afterwards till the end of flowering), 4=50% open second (caged at the first half of the blooming period and open pollination afterwards), 5=100 % open (free pollination, no caging).

Fruit set was measured three times at the branches but only the final set was evaluated in this study. All fruits were harvested from the experimental branches and each was weighted individually. So the mean mass of individual fruits was counted and this value was related to the final fruit set.

Results and discussion

The fruit sets we obtained in the experiment were rather moderate than heavy, the highest values we got approached no more than 10–14 per cent at the maximum (*Table 1*), instead of higher levels approaching some 30 per cent as generally believed to be desirable in the literature (as discussed by *McGregor* 1976). In spite of this, the limitation of the duration of the effective bee pollination period definitely affected the fruit set of all the four sour cherry cultivars (*Table 1*). In general, self fertile cultivars received much higher fruit set at the open pollinated branches than the self-sterile cultivar tested.

However, the sensitivity of the cultivars seemed to be different against the limitation of the bee pollination period. One of the self-fertile cultivars (*Debreceni bőtermő*) and the tested self-sterile variety (*Pándy 279*) were much more affected than the other two self-fertile cvs (*Ujfehértói fürtös*, *Kántorjánosi*).

Interestingly, all tested cultivars received much smaller set when the insect pollination period was limited in the first half than in the second half of the blooming (*Table 1*). This could be the effect of the changing weather during the blooming period of sour cherry trees as indicated for other fruit tree species by *Benedek* et al. (2000), who find that smaller set occurred in the firsts half of the blooming in some instances but the opposite happened, the set was higher at the second half of the blooming, at the same fruit species in other years.

Finally, the indispensable role of bees in the pollination and the fruit set of both self sterile and self fertile cultivars has been proved in this study as indicated in a number of experiments before (*Benedek & Nyéki* 1995, 1996a, *Benedek, Nyéki & Szabó* 1990, *Benedek* et al. 2000). For this reason, no doubt that all (self-sterile and self-fertile) kinds of sour cherry cultivars clearly need supplementary bee pollination to achieve a satisfactory yield.

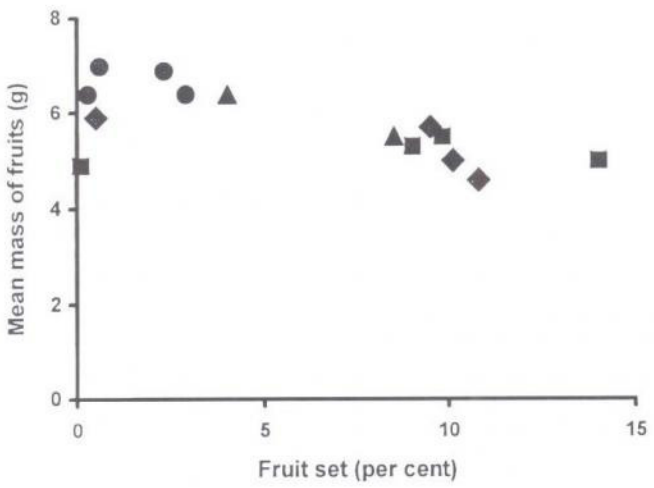
Table 1 Final set and the mean mass of individual fruits at sour cherry trees as affected by the limitation of the effective bee pollination period (Ujfehértó, 1998)

Cultivar	The effective duration of the bee pollination period (per cent)	Final fruit set (per cent) (n=4)	Mean mass of individual fruits (g)
Ujfehértói fürtös (self fertile)	0% (caged)	0	–
	35% open	10.1 ± 3.9	5.0 ± 0.2 (n=21)
	50% open first	0.5 ± 0.5	5.9 (n=1)
	50% open second	9.4 ±0.8	5.3 ± 0.2 (n=30)
	100% open	10.8 ± 5.3	4.6 ± 0.1 (n=35)
Kántorjánosi (self fertile)	0% (caged)	0	–
	35% open	14.0 ± 8.6	5.0 ± 0.1 (n=31)
	50% open first	0.1 ± 0.1	4.9 (n=1)
	50% open second	9.6 ± 1.8	5.5 ± 0.1 (n=27)
	100% open	9.5 ± 1.4	5.7 ± 0.4 (n=12)
Debreceni bőtermő (self fertile)	0% (caged)	0	–
	35% open	3.1 ± 3.1	*
	50% open first	0	–
	50% open second	4.0 ± 2.7	6.4 ± 0.2 (n=7)
	100% open	8.8 ± 4.4	5.5 ± 0.1 (n=22)
Pándy 279 (self sterile)	0% (caged)	0	–
	35% open	2.4 ± 0.7	6.9 ± 0.2 (n=7)
	50 % open first	0.3 ± 0.3	6.4 (n=1)
	50 % open second	0.6 ± 0.3	7.0 ± 1.3 (n=2)
	100 % open	2.7 ± 1.0	6.4 ± 0.3 (n=8)

*destroyed

On the other hand, the mass of individual fruits seemed to be more or less proportional with the final set at all cultivars tested because smaller sets were connected to greater, while greater sets to at least somewhat smaller fruit sizes at most instances (*Fig. 1*). However, there were very few measurements available for the individual cultivars because no more that 5 treatments were applied and the total exclusion of bees (0% open) failed to produce any final set and yield at all of the cultivars tested. This means, that no more but at least four data pairs were available on the relationship between the final set and the mean mass of fruits for a single cultivar. This is not enough to analyse the dependence of fruit sizes (their mean mass) on the final fruit set statistically in the case of individual cultivars tested.

The cultivars tested are characterised by somewhat different mean fruit sizes (*Nyéki* et al. 2000). First of all, the tested self-sterile variety (*Pándy 279*) is regarded to have greater mean fruit mass that the others (6.3 g in average). This variety, however, is known to get always much smaller



Explanation: ◆ = *Ujfehértói fürtös*
■ = *Kántorjánosi*
▲ = *Debreceni bőtermő*
● = *Pándy 279*

Figure 1 The mass of fruits as dependent on the final set of selected sour cherry cultivars (Ujfehértó, 1998)

fruit set than the other tested cultivars. The fruit set of that was even much lower than general in our experiment (1.5 per cent in average only) and its mean fruit mass was somewhat greater (6.7 g) than the typical average (6.3 g). The characteristic fruit sizes of the other tested cultivars are not so great and these are much more close to each other (being 5.6 g of *Kántorjánosi*, 5.5 g of *Ujfehértói fürtös* and 5.3 g of *Debreceni bőtermő*).

In spite of these facts, attempt was made to analyse all the available data pairs collectively to explore the relationship between the final fruit set and the fruit size (the mean mass of fruits). This attempt has been considered to be justified because relationship seemed to exist more or less at the cultivar level (*Fig. 1*) as mentioned above. As a result, a fairly reasonable and significant negative correlation was detected between the final set and the mean mass (the size) of the fruits ($r=-0{,}66$, $n=14$, $p<0.01$). The relationship was also attempted to analyse excluding the data for *Pándy 279* that was characterised by much greater fruit size than the other varieties. In this case the relationship was also negative but it was much less expressed and it was not statistically significant ($r=-0.4$, $n=10$, not significant at the $p=10\%$ level). Accordingly, the significant negative correlation with *Pándy* is rather a function of the small setting capacity of this cultivar and of its genetically greater mean fruit size than of a valid relationship between the set and the fruit size in general.

Based on these findings we could not call in doubt the statement of *Griggs* (1970) who was claiming for smaller fruit sizes, as the fruit set was heavy at sweet cherries. This relationship seems to exist in case of sour cherry cultivars, too. The relationship, however, has not been find to be definitely expressed at the moderate level of fruit set we obtained in our experiment (*Table 1*). For this reason, further research is needed to explore that level of fruit set that can notably reduce the fruit sizes to an undesirable extent.

McGregor (1976) has discussed the statements on the recommended number of honeybee colonies for sweet and sour cherry pollination. He found that the literature was largely conflicting in this respect and finally he concluded that 5 bee colonies per acre (that is some 10 bee colonies per hectare) were required to the pollination of tart cherry (that is of sour cherry) plantations. In our experiment no more than two bee colonies were moved to the sour cherry orchard per hectare. This amount of bees, however, was not enough to receive more than a small to moderately low fruit set at the open pollinated branches of any of the four cultivars tested. Regarding the optimum of bee colonies to be moved into the sour cherry plantations recommendations of *McGregor* (1976) are to be considered.

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