

Effect of introduction of mason bees on yield and quality of pear

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Abstract

*In 2019 experiments were carried out in 3 orchards in The Netherlands in Conference and Sweet Sensation pear varieties. In order to investigate the effect of mason bees on pollination, *Osmia bicornis* and/or *Osmia cornuta* were introduced at nesting facilities at one side of the orchard. Fruit set, fruit yield and quality were measured close (3 m distance) and far (>130 m distance) from nesting facilities. In one of the orchards, abundance of *Osmia* bees, honey bees, wild bees and hoverflies was determined during bloom. In the other orchards, only the abundance of *Osmia* and honey bees was observed. As the experiments will continue next year, preliminary results on bee visiting rates, pollen analysis, and yield and quality measurements are presented.*

Keywords: Pear, pollination, yield, *Osmia bicornis* L., *Osmia cornuta* (Latreille)

Introduction

Pollination can be problematic in certain pear varieties. The uncertainty may be enhanced because of climate change, which may result in adverse weather circumstances during bloom. As various types of pollinators act different under unfavourable conditions such as low temperatures or high wind speed, a greater diversity of pollinators could result in more yield stability. Different sizes of pollinators, and the way the flower is approached, can have effect on pollination efficiency as well. It has been shown in apple, that with increasing functional group diversity of pollinators (based on nesting, sociality and size) seed set and pollen limitation increased (Blitzer et al, 2016). Honey bees and bumble bees have long been used by fruit growers for pollination. Recently, the introduction and management of mason bees in orchards has shown to be an interesting option for both apple and pear (Gruber et al, 2011; Maccagnani et al, 2007). In a two-year project, the effect of managed mason bees on yield and fruit quality of pear is measured, and the diversity of wild pollinators is investigated. Results are presented of the first year of trials.

Material and Methods

At two orchards with pear cv Sweet Sensation in 't Goy and Cothen, *Osmia cornuta* (Latreille) mason bees were introduced at 2 wooden nesting facilities per orchard, consisting of 252 O-shaped 8-mm diameter holes. Per nesting facility, 646 cocoons were introduced, with a male:female ratio of 2:1. Cocoons were released on March 27, after 2 days pre-warming at 21 degrees. Bloom was expected around April 8, but due to cold weather circumstances, actual bloom started around April 15. Four windows of 2x2 m were marked at both 3 m and 130 m from the nesting facilities. In each window, 5 flower clusters were marked. Fruit weight and quality were determined close to and far away from nesting facilities, with random samples of 50 fruits per window. Pollen was collected from the nest houses and analysed.

At location Meerssen, *O. bicornis* were introduced in a pear orchard (252 females and 1298 males per nesting aid) with cv Conference, at 4 wooden nesting facilities, consisting of 252 U-shaped 8-mm diameter holes/nesting house, at the southern edge of the orchard. On April

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4, cocoons were released in the orchard, after 7 days of pre-warming at room temperature (females) and 3 days pre-warming (males). Start of bloom was at April 7. In order to be able to harvest pollen without disturbing the larger nesting units, carton rolls were attached at one side. In the previous year, *O. cornuta* had already been introduced in the orchard. They propagated in permanent bamboo cane nesting facilities, with about 140 different sized reeds/nesting aid, of which about 9% was colonised. We roughly estimated that from each of these nesting aids around 84 *O. cornuta* individuals (male and female) would emerge. All bamboo nesting facilities were relocated to the southern part of the orchard. Honey bees were introduced during bloom at the centre of the orchard. Tree rows are North-South oriented and >250 m. long. At 3, 130 and 250 m. from the nesting units, 10 flower clusters were marked. Fruit set, fruit yield, pear diameter and number of seeds per fruit were measured in the marked flower clusters. The design was replicated 4 times in 4 tree rows. During bloom, the presence of pollinators (honey bees, wild bees and hoverflies) was monitored along five 25-m long transects close to and far away (250 m) from mason bee nesting facilities. Pollen was collected from the carton rolls and analysed.

Results

Fruit weight and quality

The average fruit weight of Sweet Sensation pears close to the nesting facilities (227 g) was significantly higher than far away from the nesting facilities (196 g), as well as the fruit diameter and the number of large seeds per pear (Table 1).

Table 1: Fruit weight and quality of pear cv. Sweet Sensation (locations 't Goy and Cothen) at distances near (3 m) and far (130 m) from nesting facilities of introduced mason bees (*O. cornuta*). I.s.d values ($P < 0.05\%$).

distance	't Goy		Cothen		average		I.s.d.
	close	far	close	far	close	far	
fruit weight (g)	231	191	222	200	227	196	23.7
fruits/flower cluster	0.55	0.85	0.75	0.50	0.65	0.67	n.s.
yield/window (kg)	53	58	63	31	58	45	n.s.
fruit diam.1 (mm)	74	69	73	69	74	69	2.7
fruit diam.2 (mm)	71	66	70	66	70	66	2.7
large seeds/pear	2.36	1.66	2.60	2.28	2.48	1.97	0.504

Table 2: Fruit weight and quality of pear cv Conference (location Meerssen) at distances near (3 m), far (130 m) and very far (250 m) away from nesting facilities of introduced mason bees (*O. bicornis* and *O. cornuta*). I.s.d values ($P < 0.05\%$).

	Meerssen			I.s.d.
	close	far	very far	
fruit weight (g)	158	172	177	ns
fruits/flower cluster	2.08	1.03	1.08	0.787
yield/cluster (g)	323	172	189	126.7
yield/window (kg)	53.2	32.5	31.7	16.14
fruit diam. 1 (mm)	60	61	63	ns
fruit diam. 2 (mm)	57	58	59	ns
large seeds/pear	0.03	0.03	0.15	ns

However, there was no effect on skewness of the fruit, calculated as the proportion of the two diameters. Due to hail damage (Cothen) and bird damage in the area close to the nesting aids ('t Goy), there was a high variation in fruit set. No significant difference in yield was measured at those locations. In Meerssen a significant difference in the number of fruits harvested per flower cluster was measured (Table 2). Close to the nesting facilities, on average 2 pears were harvested per cluster, while far and very far away from the nesting facilities, 1 pear/cluster was harvested. This resulted in significant yield differences per 2 m long window.

Transect measurements

Mason bee introduction in the Meerssen orchard was just before bloom. Although *O. bicornis* was recorded more often in 10 transects (19 individuals, versus 11 *O. cornuta*), the bees hardly propagated in the nesting facilities. Five species of mining bees were observed in the orchard: *Andrena cineraria* L., *A. haemorrhhoa* (Fabricius), *A. scotica* (Perkins), *A. fulva* (Müller) and *A. nitida* (Müller) and one species of sweatbee: *Halictus rubicundus* (Christ). Abundance of honeybees and wild bees close to and far from mason bee nesting facilities was the same. Significantly more mason bees and hoverflies were seen close to the nesting facilities.

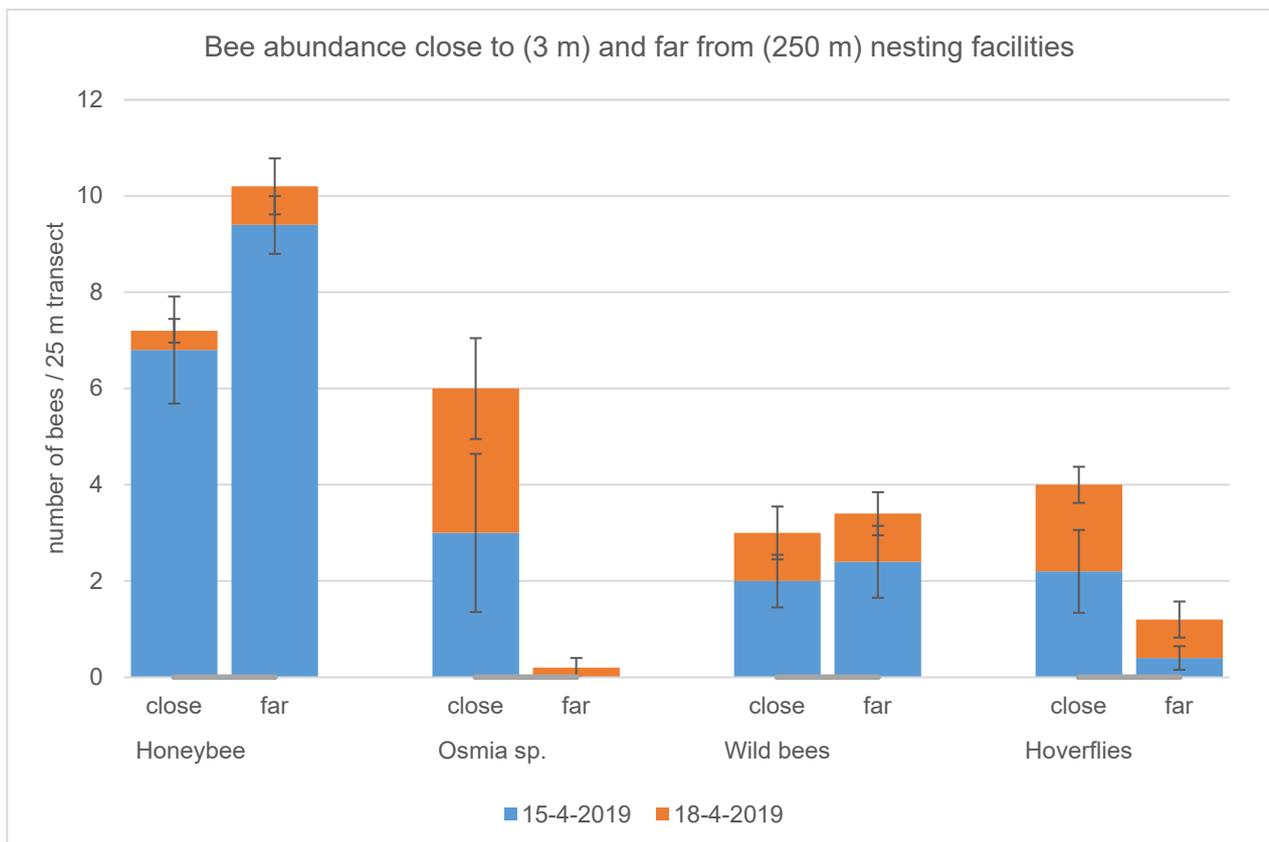


Figure 2. Results of transect measurements (25 m) for pollinating managed and wild bee species and hoverflies at location Meerssen, close and far (250 m) away from mason bee nesting facilities.

Pollen analysis

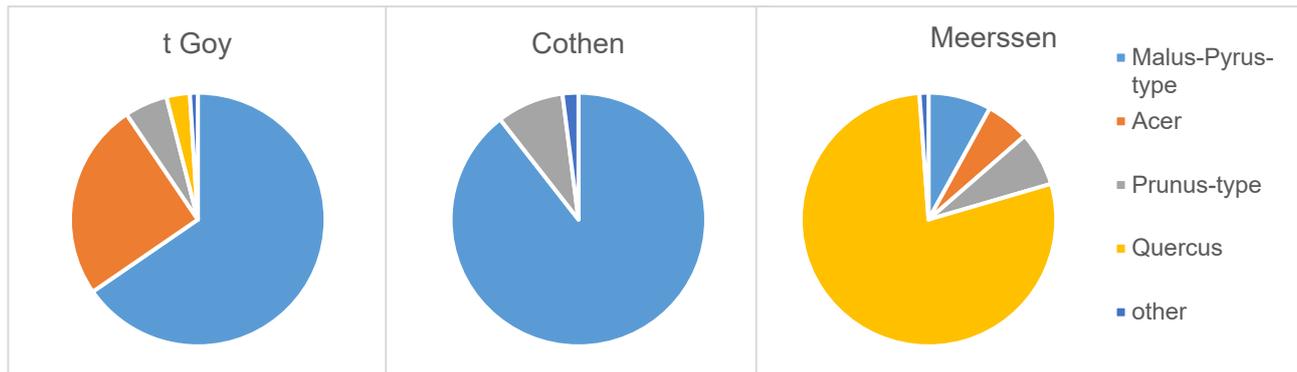


Figure 1. Results of pollen analysis of collected pollen by *Osmia cornuta* in 't Goy and Cothen, and of a mixture of *Osmia bicornis* and *Osmia cornuta* in Meerssen.

Discussion

First results of the effect of introduction of mason bees on yield of Conference pear are promising. In Sweet Sensation, there was a difference in average fruit weight, but due to losses by hail and birds, it is not possible to assess the effect on total yield. No effect was measured on the skewness of pears. In the second year of the trial, the ratio between length and width could be measured additionally, which should be <1.8 for an ideal fruit form of Conference (De Vlas *et al.*, 2010). Although propagation of *O. bicornis* in Meerssen was not successful, they were present during bloom in transect measurements. As no distinction between male and female mason bees was made, it is not clear if during bloom already all females had emerged. From the pollen analysis it is clear that *O. bicornis* females collected mainly oak pollen, while *O. cornuta* collected predominantly pear pollen. It might be interesting to (mass) introduce *O. cornuta* in Meerssen as well.

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