Encountered Pollen in Nests Two *Osmia* Species (Hym.:Megachilidae) from Sweet Cherry Orchards in Sultandağı Town (Afyonkarahisar, Turkey)

Sultandağı İlçesindeki Kiraz Bahçelerinden İki *Osmia* Türünün (Hym.:Megachilidae) yuvalarında Rastlanan Polenler

Research Article

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ABSTRACT

Osmia species (Hym.: Megachilidae) are important because they can continue even their pollinator activity in orchards in the unfavourable weather conditions for honey bees. In the study, the pollen encountered in the artificial nests of *Osmia bicornis* (L.) and *O. caerulescens* (L.) used for supporting their populations in the sweet cherry orchards were analysed. The nests were established in two cherry orchards of Sultandağı town (Afyonkarahisar, Turkey) in April of 2009 and 2010 and removed in September of the same years. Pollen samples were obtained from total 11 nests of *O. bicornis* and 6 nests of *O. caerulescens*. Total 4800 pollen grains were examined. As a result of the diagnosis studies of pollen grains, it determined that two species collected the pollens of 6 families and that the dominant pollen group belonged to the Brassicaceae (60.1%) for *O. bicornis* while Fabaceae (48.2%) for *O. caerulescens*. The second pollen group were Rosaceae (20.7%) for *O. bicornis* while Asteraceae (11.8%) for *O. caerulescens*. In the nests of *O. caerulescens*, 2.8% Rosaceae pollen were encountered. According to these results, the effect of *O. bicornis* is higher than *O. caerulescens*'s on sweet cherry pollination.

Key Words
Megachilidae, *Osmia*, artificial nest, pollen, Rosaceae.

ÖZET

Osmia türleri (Hym.:Megachilidae) bal arısı için uygun olmayan hava koşullarında bile meyve bahçelerindeki polinasyon aktivitelerini devam ettirebildikleri için önemlidir. Çalışmada, kiraz bahçelerinde popülasyonlarını desteklemek için yapay yuvalarda yuvalandırılan *Osmia bicornis* (L.) ve *O. caerulescens* (L.)'in yuvalarında rastlanan polenler analiz edilmiştir. Yuvalar, Sultandağı ilçesinin (Afyonkarahisar, Türkiye) iki kiraz bahçesine 2009 ve 2010 yıllarının Nisan ayında kurulmuş, aynı yılların Eylül ayında kaldırılmıştır. Polen örnekleri, *O. bicornis*'in 11, *O. caerulescens*'in ise 6 yuvasından elde edilmiştir. Toplam 4800 polen zerresinin incelenmesi sonucunda, iki türün 6 familyanın polenlerini topladığı ve dominant polen grubunun *O. bicornis* için Brassicaceae (%60.1)'ye, *O. caerulescens* için Fabaceae (%48.2)'e ait olduğu belirlenmiştir. İkinci polen grubu *O. caerulescens* için Asteraceae (%11.8) iken, *O. bicornis* için Rosaceae (%20.7) olmuştur. *O. caerulescens* yuvalarında %2.8 oranında Rosaceae polenine rastlanmıştır. Bu sonuçlara göre, *O. bicornis*'in kirazın polinasyonundaki etkisi *O. caerulescens*'inkinden daha yüksek gibi görünmektedir.

Anahtar Kelimeler
Megachilidae, *Osmia*, yapay yuva, polen, Rosaceae.

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INTRODUCTION

Honey bees are the main pollinator used to increase the quantity and quality of fruits in orchards. However, they couldn't work in low temperature and rainy days [1]. At this point, other pollinators in the natural fauna which adapt to local climatic conditions come into prominence. *Osmia* Panzer (Hym.: Megachilidae) species are among these pollinators. Moreover, only several female individuals of these species which are also active during unfavourable weather conditions can be sufficient for the pollination of a single fruit tree [2].

Sultandağı town (Afyonkarahisar) which located in the west of Turkey is one of the most important cherry exporter areas. However, the climate of Sultandağı is characterized by a mean temperature 9.2°C and the average number of rainy days is 19.8 during the approximately three months between bud swell and green fruit stages [3]. These climatic conditions which are limiters for honey bee activity can sometimes lead up to insufficient fertilization in the orchards. In consequence, the studies related to the determination of natural bee species and the supporting of these species increase in the area in recent years [3-5].

Osmia bicornis (L.) and *O. caerulescens* (L.) are the most common *Osmia* species in Turkey. Both species are also early-flying solitary bees and widely distributed in Europe, Central Asia and North Africa [6,7]. *O. bicornis* is a univoltine species and its flight season is from the second half of March to the middle of May in the Middle Anatolia. *O. caerulescens* is a bivoltine species and it has got a longer flight period. While its first generation is active between the beginnings of April and June, the second generation is active from July to the beginnings of August [8].

The aim of the present study was to analyse the pollen loads of these bees in sweet cherry orchards in order to answer the following questions: Which pollen types are deposited in the nest of both the bees? Is it possible to encounter the pollen of sweet cherry among these pollen loads?

MATERIALS AND METHODS

Field Area

The study was conducted in two sweet cherry orchards of Sultandağı town (Afyonkarahisar, Turkey) (38°35'03.69''N- 031°16'46''E and 38°33'47.1''N- 031°13'27''E). The artificial nests were used to support the population of *O. bicornis* and *O. caerulescens* in years 2009 and 2010. The nests were set in April (the bud swell period) and lifted in September.

Other flowering plants in the orchards were collected for preparation of reference pollen slides. All collected plant specimens were pressed and transformed to the herbarium.

For identification of *Osmia bicornis* and *O. caerulescens* species, the keys developed by Banaszak and Romasenko (1998) (6) and Scheuchl (2006) [9] were used. The plant specimens were identified by Dr. Mutlu (Inönü University, Malatya) and M.Sc. Güzel (Plant Protection Central Research Institute, Ankara, Turkey).

Pollen Analysis

The nests were dissected in October of 2010 and 2011. Pollen specimens were encountered in total 11 nests of *O. bicornis* and 6 nests of *O. caerulescens*. In the investigation was used the Wodehouse method [10] to prepare the slides in pollen samples. Basic fuchsine-glycerin-gelatine mixture taken with the edge of a sterile needle was added to the pollen pellet. The stained sample was transferred to a microscope slide and put on a hotplate set at 40°C. When the gelatine was melted, 18×18 mm^2 cover slips were placed on the samples. Pollen slides were researched with Leica DM300 microscope and immersion objective (x100) was used in the description of pollens. In the researches all the area, which is 18x18mm^2, was checked. Relevant sources were used in the diagnosis of the pollen were from Persano Oddo & Piro (2004) [11], Tüylü Özkök & Sorkun (2007) [12] and Sorkun (2008) [13] as well as prepared reference slides. The reference slides were prepared from the pollens of formerly diagnosed plant species. In order to verify the diagnosis, they were used. Total 4800 pollen

Table 1. The number of the most encountered pollen in *Osmia bicornis* (L.) and *O. caerulescens* (L.) nests.

Plant taxa	*Osmia bicornis*	*Osmia caerulescens*
Chorispora syriaca Boiss. (Brassicaceae)	1863	120
Papaveraceae	160	-
Prunus avium L. (Rosaceae)	643	47
Muscari neglectum Guss (Liliaceae)	19	-
Scrophulariaceae	346	-
Juglans regia L. (Juglandaceae)	69	-
Fabaceae	-	595
Anthriscus nemorosa (Bieb.) (Apiaceae)	-	155
Asteraceae	-	200
Castanea sativa (Mill.) (Fagaceae)	-	359
Trifolium repens L. (Fabaceae)	-	224
Total	3100	1700

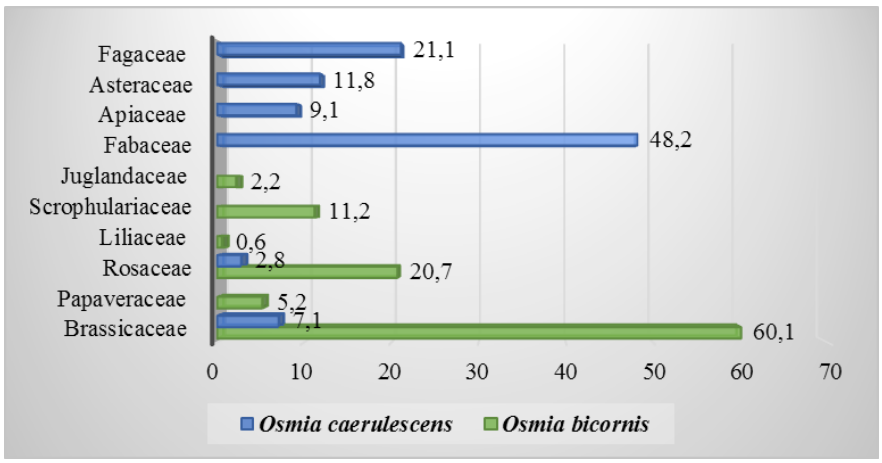

Figure 1. The percentage distribution of the most encountered pollen types in *Osmia bicornis* (L.) and *O. caerulescens* (L.) nests.

grains were analysed. While 3100 of these grains were obtained from *O. bicornis* nests, 1700 pollen were provided from *O. caerulescens* nests.

Two hundred of pollen grains were counted in each slide and percentage of pollen was calculated according to taxa. Those percentages were used to determine abundances of taxa. The following terms were used in frequency classes: dominant pollen (more than 45% of pollen grains counted), secondary pollen (16–44%), minor pollen (3–15%) and rare pollen (less than 3%).

RESULTS AND DISCUSSION

Pollen diagnosis were tried to make on the species level, but all of the samples could not be diagnosed to this level because of inadequacy of reference pollen slides. These specimens were evaluated under their associated family's names. As a result of the diagnostic studies of total 4800 pollen grains, it determined that *O. bicornis* and *O. caerulescens* collected the pollens of 6 families (Table 1, Figure 1). The most frequent pollen type identified was the Brassicaceae (60.1%) for *O. bicornis* while Fabaceae (48.2%)

for *O. caerulescens* (Figure 1). In the other study conducted in same area, it was found that *Andrena flavipe*s Panzer (Hym.: Andrenidae) also mostly prefers to collect Brassicaceae pollen (5). The second pollen group were Rosaceae (20.7%) for *O. bicornis* while Asteraceae (11.8%) for *O. caerulescens* (Figure 1). It is known that both two bee species are polylectic [7]. However, *O. bicornis* shows a tendency to partly a specialisation on Fabaceae and Rosaceae flowers. *O. caerulescens* also prefers to collect more frequent the pollen of Fabaceae and Lamiacaea [6]. *O. bicornis* is a univoltine species and its flight season is from the second half of March to the middle of May in the Middle Anatolia. Therefore, it synchronised with the flowering periods of many Rosaceae spp. including a sweet cherry.

In the nests of *O. caerulescens*, 2.8% Rosaceae pollen was encountered. According to these results, the effect of *O. bicornis* appears like higher than the effect of *O. caerulescens* on sweet cherry pollination. But, it can be not correct to this opinion because the rests from pollen loads consumed by bee larvae were analysed. It should not be forgotten that *O. caerulescens* is a bivoltine species and both the first and the second generations could use the same nest. If the analysed pollen is collected by the second generation, it is not possible that they belong to the Rosaceae because between their flight period and the flowering period of Rosaceae do not synchronize. Therefore, 2.8% Rosaceae pollen should be collected by the first generation of *O. caerulescens*.

Castanea sativa (Mill.) (Fagaceae) [14] and *Trifolium repens* L. (Fabaceae) [15] constitute a perfect pollen and nectar sources for bees because their pollen production are dominant [13]. In opposite to other plant species, there were not *C. sativa* and *Juglans regia* L. (Juglandaceae) in the sweet cherry orchards. But, it is known that *Osmia* species can fly the maximum 600 m to collect pollen and nectar from the nest [16]. Therefore, it is thought that these pollen samples were collected by the bees in the areas surrounding the sweet cherry orchards.

Osmia bicornis and *O. caerulescens* nest in pre-existing cavities such as insect burrows in dead wood and hollow stems. They overwinter as adults in their silken cocoons. After emergence in April, females mate and search for suitable nest sites. The brood cells are filled with pollen and nectar by females. After an egg is attached onto the provisions, the brood cell is sealed by a partition made of mud or chewed leave material. The provisions are consumed by larvae [7,17,18]. Normally, the adults in cocoons develop in October. However, the development in their early stages could not continue due to parasitoids, nests destroyers and predators [19]. In this study, the pollen grains were obtained from dissected nests in October of 2009 and 2010. *Trogoderma versicolor* (Creutzer) (Col.: Dermestidae) and *Melittobia acasta* (Walker) (Hym.: Eulophidae) in the same nests were detected as two major factors preventing the emergence of adult bees [4].

Pollination success for many self-incompatible plants as sweet cherry depends on the availability of wild bees [16]. The presences of plants whose pollen are collected for the larvae nutrition are important in terms of sustainability of *Osmia* species in the orchards. Destruction, deterioration and fragmentation of habitats in agricultural landscapes may disrupt the interactions between wild bees and their resources [16]. Therefore, it should be avoided from the agricultural applications which could be a negative effect on the bee fauna of the orchards.

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