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The Attractiveness of Fabre's Hives for Wild Bees *Osmia cornuta* (Latr.) (Apoidea, Megachilidae) Depending on the Structure of the Hive's Front Side

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Abstract

In the Fabre's hives, the front side of which was divided in half into lit and unlit parts, the tubes facing the lit parts of the front edge of the front side of the beehive were populated by *Osmia cornuta* females on average 1.6 times more often than the tubes facing the unlit part. The average percentage of the population of the lit areas of the front side of such hives is 48.5%, unlit – 30.8%. Hives with a fully open front part, bordered by a rim, were populated 2 times more often than hives without a rim. The percentage of colonization of nest canals increased in the following row: front side of the hive is completely open (19% of the population); the part of the front side under the shield (25%); the front side is open, but covered with rims from sides (36%); the front side under the shield with rims (37%), the open part of the front side near the shield (43%), the open part of the front side near the shield with rims (54%). Based on the generalization of the data obtained, we can assume that the selection of nesting by *O. cornuta* females is determined by two factors. On the one hand, the desire of females to choose a nesting canal which is located as covertly as possible, and on the other hand, greater or lesser orientation ability of bees of this species, in other words, ability to remember the location of the tube chosen for the nest more or less reliably.

Key words: *Osmia cornuta*, Fabre's hives structure, artificial breeding of wild bees.

Аннотация

В ульях Фабра, лицевая сторона которых была разделена пополам на освещенную и неосвещенную часть, трубки, выходящие на освещенную часть переднего края лицевой стороны улья, заселялись самками *Osmia cornuta* в среднем в 1,6 раз чаще, чем трубки, выходящие на неосвещенную часть. Средний процент заселения освещенных участков лицевой стороны таких ульев – 48,5 %, неосвещенных – 30,8 %. Ульи с полностью открытой лицевой частью, окаймленной бортиком, заселялись в 2 раза чаще, чем без бортика. Процент заселения гнездовых каналов возрастал в следующем ряду: лицевая сторона улья полностью открыта (19 % заселения), часть лицевой стороны под щитиком (25 %), лицевая сторона открыта, но прикрыта с боков бортиками (36 %), лицевая сторона под щитиком, имеющим бортики (37 %), открытая часть лицевой стороны рядом со щитиком (43 %), открытая часть лицевой стороны рядом со щитиком, имеющим бортики (54 %). Обобщение совокупности полученных данных позволяет предположить, что выбор самками *O. cornuta* места гнездования определяется двумя факторами. С одной стороны, стремлением самок выбрать гнездовой канал, расположенный максимально скрытно, а с другой, большей или меньшей способностью пчел данного вида к ориентации, то есть способностью более или менее надежно запоминать местоположение выбранной для гнезда трубки.

Ключевые слова: *Osmia cornuta*, конструкция улья Фабра, искусственное разведение диких пчел.

Osmia bees are natural pollinators of many species of melittophilous plants. Some *osmia* species willingly colonize artificial structures – so-called Fabre's hives (Malyshev, 1963). Such species are easily artificially bred and successfully used for pollination of agricultural

plants. Most *Osmia* species that inhabit hives are spring ones. These species are used for pollination of fruit trees: *Osmia lignaria* in the USA (Boschet al., 2006, and others); *O. cornifrons* in Japan (Maeta, 1990); *O. pedicornis* also in Japan (Kitamura, Maeta, 1969); *O. rufa* in Europe (Free, Williams, 1970, and others); *O. jacoti* and *O. excavata* in China (Zhou et al., 1992). Some of these species were introduced into other countries for pollination of various crops: *O. cornuta* and *O. bicornis* – USA (Torchio, Asensio, 1985), *O. cornifrons* – also USA (Kuhn, Ambrose, 1984), *O. lignaria* – Japan (Maeta, Kitamura, 1968).

There are many studies conducted in order to identify the most suitable structures of hives and materials from which nesting canals are made (Takiet al., 2008; Martinset al., 2012, and others.). Patents were obtained for hives that were most populated (Bartuli, 1979; Olifir, 1990; Ivanov, 1996; Ivanov, 2005, and others.).

The purpose of our research is to reveal the influence of some constructive features of the Fabre's hives on their attractiveness for females of wild bees *Osmia cornuta* (Latreille, 1805).

In our experiments, we used hives which differed in the structure of the front side. Variants of the hives' structure are shown in Table 1.

From the data in the table, it follows that in hives, the front side of which was divided in half into lit and unlit parts, the tubes facing the lit parts of the front edge of the front side of the beehive were populated on average 1.6 times more often than the tubes facing the unlit part. The average percentage of the population of the lit areas of the front side of such hives is 48.5 %, unlit – 30.8 %.

At the same time, the total percentage of such hives' colonization (4 to 9 variants) turned out to be higher than the percentage of colonization of hives with the front side completely open to light (variants 1–2). Variants 4 to 9 were settled by 39.7% on average, while variants 1 and 2 – by 27.7 %.

The low population of hives with a fully illuminated front side, we believe, can be explained by the orientation difficulties that bees experience in the front side of such hives devoid of visual reference points. The assumption of a significant value for the female bees of the hive's front wall illumination and references confirms a comparison of the density of the hives' population of the second variant with the first one (Table 1). The rim rising above the edges of the front part of the hive does not obscure the inlets of the tubes too much, but serves as a more visible reference than just the edge of the nest tubes. The presence of the rim has a significant effect on the population of the hive. Hives with a fully open front part, bordered by a rim, were populated 2 times more often than hives without a rim.

The percentage of colonization of nest canals by *O. cornuta* females increased in the following row: front side of the hive is completely open (19 % of the population); the part of the front side under the shield (25 %); the front side is open, but covered with rims from sides (36 %); the front side under the shield with rims (37 %), the open part of the front side near the shield (43 %), the open part of the front side near the shield with rims (54 %).

Table 1

Results of experimental hives settling with Osmia cornuta females

Number of the experiment variant and structure of the front side of the hive	Number of replications	Average number of females who settled the hive	Share of populated tubes, % $\bar{x} \pm S_{\bar{x}}^*$	
			Lit part of the hive's front side	Shaded part of the hive's front side
1	2	25	19.2	–

2		2	47	36.2	–
3		2	32	–	24.6
4		2	55	47.7	36.9
5		2	54	52.3	30.8
6		2	68	61.5	43.1
7		2	50	47.7	29.2
8		2	32	32.3	16.9
9		2	50	49.2	27.7
For 6 last variants on average		12	51.5±11.6	48.5±9.5	30.8±8.9

Based on the generalization of the data obtained , we can assume that the selection of nesting by *O. cornuta* females is determined by two factors. On the one hand, the desire of females to choose a nesting canal which is located as covertly as possible, and on the other hand, greater or lesser orientation ability of bees of this species, in other words, ability to remember the location of the tube chosen for the nest more or less reliably.

The identified bees' preferences of individual variants of the front side structure of the Fabre's hives can be used in the development of new and improved known constructions of beehives specifically designed for *Osmia cornuta* bees breeding. This can significantly increase the efficiency of artificial breeding of this species of wild bees.

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