The influence of nests usage on mason bee (*Osmia rufa* L.) survival

BEATA MADRAS-MAJEWSKA, BARBARA ZAJDEL,
ALEKSANDRA BOCZKOWSKA
Bee Division, Warsaw University of Life Sciences – SGGW

**Abstract:** The influence of nests usage on mason bee (*Osmia rufa* L.) survival. The research was performed at Apiculture Division of Warsaw University of Life Sciences – SGGW in 2004–2006. Main observations were carried in February and in March 2006. The aim of this study was to present the differences in mason bee (*Osmia rufa* L.) survival resulting from the nests usage. After opening all the tubes it was found that in annual nest quite healthy cocoons was 1618 (21%) and the loss of 6208 (79%). In the biennial nest profit was only 157 cocoons (2.5%) and the loss of up to 6075 cocoons (97.5%). Taking into account the number of healthy cocoons (profit) as well as representing a loss in both types of nests it can be noted that in the annual nest it could received more than 15 cocoons from the female. However, in the biennial nest, which can be expected more numerous population, it was achieved in one year only 11 cocoons from the female.

**Key words:** mason bees, *Osmia rufa* L., cocoons, nests.

**INTRODUCTION**

Mason bee has a high rate of reproduction and a wide food preferences. Tendency to artificial nests occupation, short period of adult forms emergence from cocoons, the ability to create clusters and colonies, as well as low workload are one of the advantages which does mason bee attractive as for a breeding species (Flaga, 2002).

Mason bee has developed several forms of protection of its species. One of them is a linear type of nest-building and appropriate gender distribution in each cell of cane tube. Fertilized eggs from which females are hatched, are placed in the further parts of the nest, and in cells located more outside are deposited unfertilized eggs. Males are more exposed to insect-eating birds or martens. Females inside the nests have bigger chances of survival (Flaga, 2002).

Another way of passive protection is to build by mason bees empty first cell in the nest tube. This is typical behavior of bees of the Osmia genus. Many Aculeata species build empty cells in a variable position and number (Krombein, 1967; Linsley, 1958; Stephen, 1969). Tactic of leaving the first cell empty or even the entire tube is designed to mislead the parasites, because the plug of larval cells does not differ from the closing caps of the blank cells (or the whole tube). An empty cell is present in more than 80% of nest traps (Balfour-Browne, 1925; Bayer-Helms, 1933; Brechtel, 1986; Jacob-Remacle, 1976).
In terms of nesting material selection mason bees are very plastic. They can inhabit the holes from knots in a tree, hollow brick slots, holes in the bricks, space between the planks and in the straw covering the roofs. Wilkaniec and Giejdasz (2001) found that mason bee can also nest in the paper tubes, plastic straws for drinking and in shrinkable insulating covers. According to their study, only the tube of cane were settled at 100%.

The most important task of rearing mason bee is to get as many populations for pollination of crops as possible (Wilkaniec et al., 2004). Suitable nesting material selection can affect the reproductive performance of these insects.

MATERIALS AND METHODS

The study was performed at the Apiiculture Division of Warsaw University of Life Science – SGGW. The experience lasted from March 2004 till April 2006. Research material was mason bee cocoons risen in annual and biennial cane nest traps. In March 2004, 1200 cocoons of mason bee were brought from the Institute of Arboriculture and Floriculture in Puławy, which after hatching colonized prepared for them cane nest tubes. These tubes were used for two seasons (from spring to autumn 2004 and from spring to autumn 2005) without the selection of cocoons and cane tubes. Nests were built of closely bind the common cane stalks, tied in bundles and loaded in the plastic cover. An average package consisted of 60–80 tubes of 18–20 cm in length and diameter of 6–8 mm. In 2004 it was prepared nest made of 1028 tubes and in 2005 made of 1102 cane tubes. So constructed nests was placed in special boxes. These boxes have been suspended at the height of 2 m on the outer wall of the building and an additional safety net covered them as the protection from birds. In the spring of 2005 from ISiK (IAF) in Puławy brought another 1200 cocoons, and bees after emergence colonized prepared for them new common reed stalks used that time only one season (from spring 2005 to autumn 2005). All the research material of two experimental years (cocoons used one season and used for two seasons) in October 2005 was transferred to a cool place (1–4°C) for overwintering. In April 2006 selection of cocoons was performed. Cocoons were removed from the tubes using a scalpel and gently cutting the tube along its axis so not to damage the inside of the cocoons. After opening nests cocoons were sorted for profit (healthy cocoons, normal) and loss (mechanically damaged cocoons, dead larvae of bees and tubes that have not been settled). The material was assessed taking into account the following parameters for the appearance of cocoons: normal (healthy) and damaged (infected).

RESULTS

After opening all the tubes it was found that in annual nest quite healthy cocoons was 1618 (21%) and the loss of 6208 (79%). In the biennial nest profit was only 157 cocoons (2.5%) and the loss of up to 6075 cocoons (97.5%) (Tab. 1). The loss consisted of empty cells, infected, moldy and mechanically damaged cocoons and also dead larvae of mason bee.

In the one-year old material, where the amount of all losses of cocoons was
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assigned to 6208, up to 5114 cocoons (82%) were infected. There were 311 empty cocoons (5%) and mechanically damaged 23 cocoons (0.4%). Died larvae of mason bee were 760 (12.24%) (Tab. 2).

In two years material on the loss consisted of 2037 infected cocoons (33.5%), 488 empty cocoons (8%) and as much as 1812 damaged cocoons (30%) that were badly formed or mechanically damaged by other emergence from the nest bees. Dead larvae were 1718 (28.5%) — Figure 1.

Knowing the exact number of tubes in both types of nests and the average number of eggs laid by mason bee females in a single tube it could be counted the expected number of cocoons, which should be found in a nest at the end of the season. Assuming that the female lays 15 eggs, inhabiting two tubes following results were received (Tab. 3).

The total number of cocoons – 7710 in the case of annual nest and 8265 in the case of biennial nest, are presumed numbers, ie the profit that could be obtained if all the cells were occupied by healthy cocoons. In the case of two year-rearing cocoons from 1200, which initiated established breeding approximately 600 individuals would be a female. From

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**TABLE 1. Number of cocoons in both types of nests**

<table>
<thead>
<tr>
<th>Type</th>
<th>Annual nests</th>
<th>Biennial nests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit</td>
<td>1618</td>
<td>157</td>
</tr>
<tr>
<td>Loss</td>
<td>6208</td>
<td>6075</td>
</tr>
<tr>
<td>Total</td>
<td>7826</td>
<td>6232</td>
</tr>
</tbody>
</table>

**TABLE 2. Type of loss in annual and biennial nests**

<table>
<thead>
<tr>
<th>Nest type</th>
<th>Type of loss</th>
<th>Annual</th>
<th>Biennial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infected cocoons</td>
<td></td>
<td>5114</td>
<td>2037</td>
</tr>
<tr>
<td>Empty cocoons</td>
<td></td>
<td>311</td>
<td>488</td>
</tr>
<tr>
<td>Damaged cocoons</td>
<td></td>
<td>23</td>
<td>1812</td>
</tr>
<tr>
<td>Dead larvae</td>
<td></td>
<td>760</td>
<td>1738</td>
</tr>
</tbody>
</table>

**TABLE 3. Estimated number of cocoons**

<table>
<thead>
<tr>
<th></th>
<th>Annual nests</th>
<th>Biennial nests</th>
</tr>
</thead>
<tbody>
<tr>
<td>1028 tubes × 7.5 cocoons = 7710 cocoons</td>
<td>1102 tubes × 7.5 cocoons = 8265 cocoons</td>
<td></td>
</tr>
</tbody>
</table>

FIGURE 1. Comparison of cocoons losses in annual and biennial nests – in percentage (%)
one female can be gained average of 15 cocoons, giving 9000 individuals that could be hatched in the spring of 2005. Assuming that 4500 of 9000 bees are females, each of which again lays an average of 15 eggs, in the second year of usage new generation should amounted 67 500 individuals. Knowing the exact number of healthy cocoons (profit) and infected cocoons (loss) in both types of nests it was ascertained the actual number of cocoons (Tab. 4).

The Table 4 shows that the actual number of cocoons in annual nest is 7.61 of cocoons per one nest tube, and in the biennial nest it was only 5.6 cocoons per one tube. Taking into account the number of healthy cocoons (profit) as well as representing a loss in both types of nests it can be noted that in the annual nest it could received more than 15 cocoons from the female. However, in the biennial nest, which can be expected more numerous population, it was achieved in one year only 11 cocoons from the female.

**DISCUSSION**

In recent years, due to the low profitability of beekeeping and the continuing phenomenon of bees dying decreased number of honey bee colonies. Therefore, the solitary bees are increasingly used to pollinate crops, garden and trees in orchards (Flaga, 2002).

Mason bee survival in annual nests is much higher (21%) than in biennial nests (2.5%). In annual nests infected cocoons represented significantly greater loss (82%) than in biennial nests (33.5%). Lack of cocoon selection was the cause of population decrease in the second year of nest usage. The survival of mason bee was mainly determined by cleanliness and order appliance, because the sanitary conditions have a direct impact on the viability and number of offspring.

In such situation it can be supposed that in subsequent years without replacement of nesting material the mason bee cocoons losses would be even greater. Therefore one of the most important elements of rearing the bees is the use of a annual nesting material. Nest material used once should be destroyed such as burned (Krunič et al., 2001). In this way, we can increase the probability of healthy cocoons appearance and increase the mason bee population needed to effective pollination of crops (Wilkaniec et al., 2004).

**CONCLUSIONS**

1. In annual as well as biennial nests there are healthy cocoons (profit) and infected cocoons (loss).
2. Mason bee survival in annual nests is significantly higher (21%) than in biennial nests (2.5%).
3. In annual nests infected cocoons represented significantly greater loss (82%) than in biennial nests (33.5%).

4. Lack of cocoon selection was the cause of population decrease in the second year of nest usage.

5. The survival of mason bee was mainly determined by cleanliness and order appliance, because the sanitary conditions have a direct impact on the viability and number of offspring.

REFERENCES


BRECHTEL F., 1986: Die Stechimmenfauna des Bienienwaldes Und seiner Randbereiche (Süfflaz) unter besonder Berücksichtigung der Ökologie kunstnestbewohnender Arten, Politchini, Bad Durkheim.


MS. received September 2011

Authors’ address:
Pracownia Hodowli Owadów Użytkowych – SGGW
ul. Nowoursynowska 166
02-787 Warszawa
Poland
e-mail: beata_madras_majewska@sggw.pl