

**THE TWO-QUEEN CASCADE METHOD AS AN  
ALTERNATIVE TECHNIQUE FOR STARTING BUMBLE  
BEE (*BOMBUS*, *HYMENOPTERA*, *APIDAE*) COLONIES  
IN LABORATORY CONDITIONS: A PRELIMINARY  
STUDY**

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**S u m m a r y**

When bumble bee queens are kept in pairs under laboratory rearing condition, one queen of a pair becomes dominant and lays eggs in most cases after one or two weeks. If the queens remain together, the submissive one is usually killed over several consecutive days. The losses can be avoided by putting the submissive queens in couples at the second level, and successfully the process can even be repeated once more so that three levels of pairs can be used. The method was successful in *B. terrestris*, and *B. pascuorum*, and partially in *B. lucorum*, and *B. lapidarius*. The advantages and disadvantages of the technique are discussed.

**Keywords:** Bumble bees, *Bombus*, *B. terrestris*, *B. lucorum*, *B. pascuorum*, *B. lapidarius*.

**INTRODUCTION**

To start bumble bee queens' oviposition in laboratory conditions various methods can be used. The basic ones are the confinement of single queens, (Hasselrot 1953), two queens together (Sladen 1912), queens with a brood from another nest or queens with several workers caught in nature (Medler 1958). This was all done in the spring corresponding to the yearly life cycle of the bumble bee. As a result of the contribution of several other authors (Plowright & Jay 1966, Ptáček 1983, and Roseler 1984) all the year round laboratory rearing of *Bombus terrestris* was possible (Eijnde van den, Ruijter de, Steen van den 1991). From that time various modifications of the known techniques have been tested in order to achieve a larger proportion of successful colony initiations and this regardless of the season (Duchateau & Velthuis 1989 and many others). In this short report the preliminary results of two methods are presented in order to direct the reader's attention to a simple method of starting with two queens together in one laboratory box.

## THE MATERIAL AND METHODS

Common plastic kitchen boxes of various dimensions with a cardboard bottom layer were supplied with a source of sugar solution and pollen and were used to start colonies. Trials were conducted under generally known conditions - darkness, constant temperature and humidity omit' insert. Two queens were put together into each box regardless of whether they were hibernated artificially or taken from nature.

Since we knew about the danger of queens omit' battling after some time (Duchateau 1991), the queens' behaviour was regularly observed and the pairs were divided as soon as the dominant queen laid her first eggs. The subordinate queens were then used to make another pair. As a parallel experiment queens were used together with male cocoon(s) from another colony. First *B. terrestris* was the object of our attempts, and later, as a result of the experience gained, our attempts were extended to *B. pascuorum* and *B. lapidarius*, and *B. lucorum*, too.

## RESULTS AND DISCUSSIONS

Data obtained from *B. terrestris* is summarised in table 1 and that for *B. pascuorum* in table 2. As is obvious from table 1, in *B. terrestris* the double-queen method brought more positive results than the parallel trials, using single queen and a cocoon. In both experiments the percentage of started cells was higher than the number of queens, which succeeded in rearing worker brood. This might be caused by a so far unknown pathogen. It brought on the phenomenon of „dark larvae” followed by the high mortality rate in several partial trials in 1966 and 1977 (for details see in Přidal, Sedláček, Marvanová 1997). In 1977 our improved success could be caused by the fact that the trials were conducted under more sterile conditions as well as by our greater experience.

Taking into account the presented data only, the better results from the two-queen method do not seem to be very convincing. But this technique has several other advantages, which should be realised. Queens do not need to be in brooding conditions at the start of a trial. During several days or even weeks they awake from their eventual post-diapause stage and start to be active. Another positive fact is the behaviour of queens. Several (at least two) queens together remain relatively quiet in confinement, whereas single queens try to escape constantly. Giving queens male cocoons is possible only when parallel more advanced colonies are to hand, which is not always the case.

The two-queen method needs no special conditions, only careful observation of the queens' behaviour. After some time one of the queens (the dominant one) becomes broody and starts to excrete wax. Within one or two days she constructs a brood cells and lays eggs. At this moment the other

(subordinate) queen has to be removed. The time interval at which a particular behaviour occurs varies considerably according to the physiological state of the queens at the start of a trial. Whereas queens awakening from diapause may sleep for some weeks, the searching ones in nature respond more quickly. If mature queens from nature are used, the danger of mutual attacks seems to be higher. The same is evident concurrently in the continuing season. Queens caught early in spring seem to be more peaceful.

Table 1

Results of two methods of starting bumblebee colonies - *B. terrestris*  
 Porównanie dwu metod inicjacji rodzin trzmiela ziemnego - *Bombus terrestris*

Year Rok	Queens in Experimentn Liczba matek w doświadczeniu	Brood cells started Sklądających jaja		Workers developed Wyprowadzających robotnice	
		Number Liczba	%	Number Liczba	%
<b>Single queen + mate cocoon - Pojedyncze matki + kokony samicy</b>					
1996	22	6	27.3	6	27.3
1997	34	23	66.6	14	41.2
<b>Total - Razem</b>	<b>56</b>	<b>29</b>	<b>51.8</b>	<b>20</b>	<b>35.7</b>
<b>Queens in pairs - Matki w parach</b>					
1996	60	33	55.0	23	38.3
1997	94	82	87.2	41	43.6
1998	16	12	75.0	12	75.0
<b>Total - Razem</b>	<b>170</b>	<b>127</b>	<b>74.7</b>	<b>76</b>	<b>44.7</b>

Table 2

Results of the two-queen method of starting bumblebee colonies - *B. pascuorum*  
 Wyniki dwumatecznej metody inicjacji rodzin trzmiela rudego - *B. pascuorum*

Year Rok	No. of queens Liczba matek	Brood cells - Jaja		Workers - Robotnice	
		Number Liczba	%	Number Liczba	%
<b>Queens in pairs - Matki w parach</b>					
1998	7	7	100	5	71.4
1999	12	10	83.3	9	75.7
<b>Total - Razem</b>	<b>19</b>	<b>17</b>	<b>89.4</b>	<b>14</b>	<b>73.7</b>

Another merit of the method is the fact that the more advanced queens start sooner, and later on their workers can be used as helpers to queens slower in development. In this way we were able to obtain quite successful results especially in the case of *B. pascuorum*, where values exceeding 70% were

obtained. The two-queen method seems to be useful also in the case of other bumble bee species. It is a way for starting colonies just at the very beginning. During the years 1999 and 2000 we were also able to obtain promising results in species like *B. lapidarius* and *B. lucorum*, but these have still to be analysed.

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**DWUMATECZNA KASKADOWA METODA JAKO  
ALTERNATYWNY SPOSÓB INICJACJI RODZIN TRZMIELI  
(*BOMBUS*, *HYMENOPTERA*, *APIDAE*) W HODOWLI  
LABORATORYJNEJ (BADANIA WSTĘPNE)**

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**S t r e s z c z e n i e**

W hodowli laboratoryjnej utrzymywanie matek trzmieli parami przyspiesza składanie jaj przez jedną z nich. Z chwilą stwierdzenia założenia pierwszej woskowej miseczki z jajami należy usunąć z takiego ulika drugą matkę, w przeciwnym wypadku zostanie zabita przez towarzyszkę. Z usuniętych matek można tworzyć następne pary drugiego i trzeciego rzędu. Opisana metoda dała zadowalające wyniki w hodowli trzmiela ziemnego (*Bombus terrestris*) i rudego (*B. pascuorum*), a częściowo także trzmiela gajowego (*B. lucorum*) i kamiennika (*B. lapidarius*).

**Słowa kluczowe:** Trzmiel, hodowla, *Bombus*, *B. terrestris*, *B. lucorum*, *B. pascuorum*, *B. lapidarius*.