Multiple utilization of queenless colonies in mass honey bee queens' rearing

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INTRODUCTION AND AIM OF THE OBSERVATION

Rearing the bee queens can be performed in the presence of the queen in a nurse colony however a higher effectiveness can be reached in queenless colonies (Fell, Morse 1984, Chuda-Mickiewicz, Prabucki 1995) and in the absence of emergency queen cells (Free et al.1984). In an extensive queen rearing when queen cells are incubated in a nurse colony, the colony can be used one or two times. In a continuous rearing, when the nurse colony is used repeatedly, it should be strong, healthy and with brood of different age (Pidek 1999). These conditions enable rise about 180 queen cells during one month of rearing (Burtov 1972). The highest acceptance of larvae Kruk and Skowronek (2002) obtained in the first five series of queens' rearing (45-50%), and in the second ten-day-period of May it was 55.8%. In the next series the percentage of accepted queen cells was lower, and from the 10th series it did not exceed 40%.

The aim of the observation conducted in the breeding apiary in Apiculture Division in Pulawy was to verify the efficiency of rearing queens with multiple usages of queenless colonies.

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METHODS

The observation was carried out in 2005 and 2006 in the breeding apiary of the Department of Bee Breeding, Apiculture Division in Pulawy, Poland. Bee queens were reared in 61 queenless colonies in "Dadant" and "Wielkopolski" type hives with 3 brood and 2 storage (honey and pollen) combs. Rearing frame with 1-day-old grafted larvae was placed in the center of the colony. When capped queen cells were moved into incubators, the next series of grafted larvae was placed into rearing colonies. Each nurse colony was provided with the brood combs taken from support colonies every 10 days of rearing period.

The efficiency of rearing queens was assessed as:

-% of incubated queen cells in relation to grafted larvae

-% of emerged queens in relation to grafted larvae

Two-way ANOVA was used for statistical calculation and Duncan's multiple range test was applied to determine significant differences between the means.

RESULTS AND DISCUSSION

During three years of observation a total of 30 210 larvae were grafted into 61 nurse colonies in a total of 574 of rearing series (repetitions). Each rearing series (grafted frame) contained on average 55 larvae (from 45 to 110). Altogether 18 372 larvae were accepted and queen cells incubated. Significantly lowest number of queen cells was incubated in the last year of the research and respectively the lowest number of queens emerged (tab. 1). However, in relation to a single nurse colony the highest rearing efficiency was observed that year. Single nurse colony with the best efficiency in 2005 raised 248 queen cells, in 2006 – 328 queen cells and in 2007 as many as 378 queen cells.

The highest number of isolated queen cells was in May and July, however in 2005 and 2006 the best result of larvae acceptation was observed in the second part of May. Nevertheless there were no significant differences between percentages of accepted larvae in May, June and July of 3 years of queens' rearing. Significantly lower percentage of isolated queen cells was observed in August (tab. 2). There were no differences between percentages of emerged queens in relation to grafted larvae in successive months of rearing with the exception of August 2005. Based on these and other authors' observations, June seems to be the most profitable month for queens' rearing.

Percentage of accepted larvae (incubated queen cells) in successive series, regardless the month of rearing, did not differ. In 2005 it was from 59.1% to 69.2% in 10 series. The effectiveness of queens' rearing was increasing from 53% in the first series up to 87% in 16th series in 2006. In 2007 the highest percentage of accepted larvae was in first five series but in successive it dropped to 32% (tab.3).

Table 1.

Continuous honey bee queens' rearing efficiency in the years of 2005-2007.

Year of observation	Rearing period	Number of nurse colonies	Number of rearing series	Numer of grafted larvae	Incubated queen cells		Emerged queens	
					n	%	n	%
2005	V -VII	25	173	9630	6211	63.7 b	5417	55.6 b
2006	V- VII	22	205	11345	7223	63.9 b	6363	56.2 b
2007	V- VII	14	169	9235	5298	57.3a	4451	48.1 a
total		**61**	**547**	**30210**	**18732**	**61.8**	**16382**	**53.5**

a,b – significant differences at $p \leq 0.05$

Table 2.

Honey bee queens' rearing efficiency in particular months of the years of 2005-2007.

Rearing month	Numer of series	Numer of grafted larvae	Incubated queen cells		Incubated queen cells	
			n	%	n	%
May	143	8165	5142	62.4 b	4317	52.3 b
June	302	16455	10573	64.2 b	9307	56.4 b
July	100	5480	2995	54.6 b	2588	47.1 b
August	2	110	22	20.0 a	19	17.3 a
total	**547**	**30210**	**18732**	**61.8**	**16231**	**53.5**

a,b – significant differences at $p \leq 0.05$

Table 3.

Effectiveness of queens' rearing in successive series.

Successive series of queen rearing	2005			2006			2007		
	Numer of nurse colonies	Accepted larvae %	Emerged queens %	Numer of nurse colonies	Accepted larvae %	Emerged queens %	Numer of nurse colonies	Accepted larvae %	Emerged queens %
I	25	64.7 a	53.5 a	18	58.9 ab	49.5 a	14	60.1bcd	47.1bcd
II	25	65.4 a	56.6 a	17	61.3 ab	53.9ab	14	69.8d	55.9bcd
III	24	63.8 a	55.9 a	21	53.2 a	46.8 a	14	57.0bcd	48.7bcd
IV	23	62.9 a	56.3 a	19	68.6 ab	61.2ab	14	74.0d	65.7d
V	18	62.2 a	54.8 a	19	61.1 ab	51.7 a	14	60.9bcd	55.9bcd
VI	19	63.4 a	55.3 a	21	65.1 ab	56.2ab	14	57.3bcd	44.7bc
VII	19	66.1 a	58.3 a	17	66.2 ab	57.2ab	15	59.9bcd	48.7bcd
VIII	12	59.1 a	54.4 a	13	62.4 ab	58.8ab	13	58.0bcd	48.5bcd
IX	5	58.8 a	54.8 a	14	65,8 ab	59.6ab	13	56.8bcd	47.1bcd
X	3	69.2 a	51.7 a	12	71.0 b	63.2ab	12	50.1bc	43.5bc
XI	-	-	-	13	72.0 ab	65.6ab	11	48.7abc	43.1bc
XII	-	-	-	9	62.2 ab	54.7ab	10	43.8ab	37.4ab
XIII	-	-	-	8	66.4 ab	58.6ab	9	31.8 a	23.2a
XIV	-	-	-	2	70.1 b	60.9ab	2	66.4cd	60.9cd
XV	-	-	-	1	81.8 b	63.6ab	-	-	-
XVI	-	-	-	1	87.3 b	80.0 b	-	-	-
total	**173**	**63.7**	**55.6**	**205**	**63.9**	**53.2**	**169**	**57.3**	**48.1**

a,b – significant differences at $p \leq 0.05$
Sd- standard deviation

Table 4.

Percentage of accepted larvae and emerged queens in relationship to number of rearing series.

Queens' rearing series	Total number of rearing series	Number of nurse colonies (from-to)	Accepted larvae %	Emerged queens %
I – V	279	22-26	62,9 b	54,3 b
VI - X	202	13-21	62,1 b	53,8 b
XI – XVI	42	1-13	53,8 a	46,1 a
total	**557**	**49**	**61,8**	**53,5**

a,b – significant differences at $p \leq 0.05$

Altogether in three years of observations in the highest number of nurse colonies (22-26) five series of honey bee queens were performed, then six to ten series were performed in 13 to 21 nurse colonies and even more than ten series in 1 to 13 nurse colonies (tab.4). Percentage of accepted larvae did not differ in the first ten series of queens' rearing. Only in the next series it was lower and came to 53.8%. Similar findings were done for the number of emerged queens.

CONCLUSIONS

1. Single nurse colony during rearing period can produce even more than 300 bee queens.
2. The highest larvae acceptance is in June.
3. Effective continuous rearing in a queenless colony can be performed even longer than for 10 rearing series.