Problems With Queen Banks

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The method of storage of several queens in one colony has many advantages, but it also has serious disadvantages.

STORAGE OF queens in the so-called "queen banks" is commonly practiced in commercial queen rearing. The queens are caged and several of them are put into a holding frame which is located in a queenless colony in a super which is separated by a queen excluder from a queenright colony. Queen banks are used for queens mated naturally, as well as for those inseminated instrumentally.

According to Laidlaw (1954) Laidlaw and Eckert (1962) Mackensen and Tucker (1970) mature queen cells are put into individual cages. The cages are placed into holding frames which are put into a strong queenless colony. The queens emerge here and are fed by worker bees through the mesh of the cages. Queens to be mated naturally, are introduced into nuclei as virgins. Mature queen cells are also put directly into those nuclei. After the queens are mated, and after they have started to lay eggs, they are caged and stored in queen banks until they can be used or sold.

Queens to be inseminated instrumentally are very often caged in storage colonies until they are inseminated at the age of 7-10 days (Laidlaw 1954, Mackensen and Tucker 1970, Harbo 1985). After insemination the queens are very often stored in the same colony.

The equipment for queen storage varies. Some beekeepers cage the queens in individual cages and keep them in holding frames in the storage colonies (Laidlaw and Eckert 1962, Reid 1975, Levinsohn and Lensky 1981). Others prepare longer bars with several holes of 2 — 2.5 cm diameter. The holes are covered either with a queen excluder (Harp, 1967) or with metallic mesh (Dietz and Wilbanks 1983).

In China, a Langstroth frame is divided, by horizontal and vertical bars into 28 compartments, screened from both sides (personal observations). Harbo (1985) developed an advanced method of the collective handling of queens. Instead of a frame, he used 13 mm thick plywood cut to the same size as a frame. Queens are stored in 35 screened holes measuring 24 mm in diameter.

Sometimes the queens are stored for a short period only. But other times, both, naturally as well as instrumentally inseminated queens are stored for several weeks or months (Reid 1975, Levinsoho and Lensky 1981, Harbo 1986) or are even overwintered in the queen banks (Harbo 1967, Szabo 1977 and Dietz and Wilbanks 1983).

The number of stored queens varies. But sometimes storage of a high number of queens is reported. Harbo (1985) stored 75 instrumentally inseminated queens in a colony. Laidlaw and Eckert (1962) described storage of 312 naturally mated queens and Dietz and Wilbanks (1983) of 360 ones. Since the publication of Free and Buttler (1958) attention has been paid to the size of apertures of the screen which covers the cages. The above authors found that workers can thrust their tongues through wire-gauze with apertures of 1.5 mm and imbibe syrup placed 1 mm

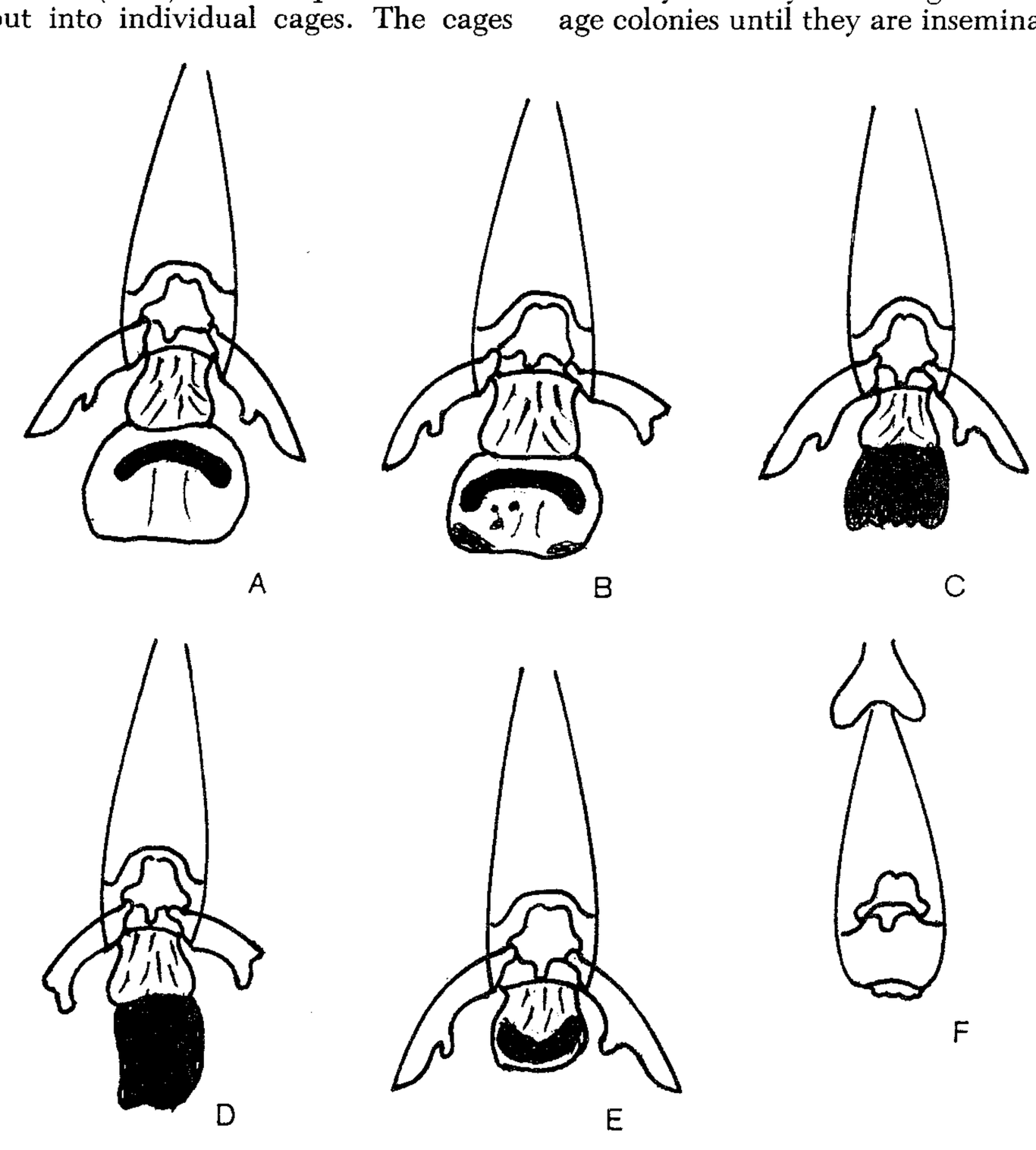

Fig. 1. Injuries of pretarsus — A — normal, B — black spots on arolium and lack of one point of one claw, C — black arolium, D — black arolium and lack of one point on each claw, E — arolium dry and folded up, F — pretarsus bitten off.

apart. But workers will feed other workers through wire-gauze with 2.5 apertures, which allows antennae contact between two bees. They conclude that apertures of not less than 2.5 mm square are desirable in wire-gauze used for queen cages and suggest that wire-gauze used for queen cages should have apertures as large as is possible, without allowing bees to pass through. Consequently, screens with 2.5 mm apertures are used mostly now. Levinsohn and Lensky (1981) even used cages with wire screen mesh 3.0 or 3.5 mm.

The method of storage of several queens in one colony has many advantages, but it also has serious disadvantages. When instrumentally inseminated queens are caged for two days after insemination, semen is retained in oviducts of some queens (Vesely, 1970) which subsequently die, and low numbers of spermatozoa enter the spermatheca when workers do not have direct access to the queens (Woyke, 1979).

But the phenomenon which discourages storage of queens in queen banks are injuries of queens by worker bees. All researchers testing storage of queens applied survival rate of queens as a test of success of that method.

But Woyke, et al., (1956) found 30 years ago that worker bees injured the queens when several of them were stored in a colony. The experimental queens were stored in cages covered with wire-gauze with apertures of 0.2 mm, 1.2 mm and 3 mm. The workers could not thrust their tongues through the smallest apertures. However, they could do that through the larger apertures and they also could thrust part of their head with the mandibles through the largest ones. After 8 days, 0.0, 93.3, and 83.3% of queens survived, respectively. More queens survived in cages with gauze meshes of 1.2 mm than of 2.3 mm, but the percentage of non-injured alive queens was 0.0, 93.3 and 33.3%, respectively. Thus, queens in cages with gauze which did not permit the contact with workers died, but with the larger the apertures more queens were injured. Further investigation showed that queens in cages with slots were injured even more. The workers bite claws, tarsi, antennae and even wings. According to Jasinski (1986, 1987) 60% of 354 queens stored for 1 week in queenless colonies were injured. He detected 26 different types of injuries. The first injuries concerned the arolium also called the food pad. It is normally white and soft. When it is injured slightly, black spots can be found on it. More severely injured arolia are black, dry and shrunken (Fig. 1).

Injuries of queens were found in different countries. Jasinski found in 1977, 12.5% injured queens imported to Norway from the USA. Woyke found in 1986, 40% injured queens stored in China and in 1987, 64% injured queens stored for 10 days in Egypt.

Lensky and Slabezki (1981) recorded an oily colorless exudate deposited, from the foot-pad of a queen. This is the so-called food-print which, together with the mandibular gland secretion, inhibits the construction of queen cell cups. Woyke (1987, not published) found that queens with black arolia do not deposit the food-print. It may be assumed that such queens are superseded by worker bees. Although Szabo (1977) concludes that no significant differences exist in loss and supersedure of queens overwintered in a storage colony or each in a small colony, his data (his Tab. 2) shows that from May to October, 62% of stored queens were lost and only 33% of those overwintered in separate colonies.

Investigations were undertaken to decrease the percentage of queens injured in queen banks. When workers were added to every cage with queens, then not only the queens were injured, but also the attendant workers. When wire screens were replaced by queen excluders, the queens were injured, also.

In 1987 storage of queens in cages with gauze of different apertures was investigated, as well as storage in cages with single and double gauze. Queens with the slightest injuries to their arolium were classified as injured. Table 1 shows that in July a similar percentage of 91-92% of the queens survived in cages with gauze apertures of 1.5 and 2.5 mm. But 38% non-injured queens were found in cages with smaller gauze apertures of 1.5 mm, while only 23% in cages with larger apertures of 2.5 mm. In the second half of August also 90% of queens survived in cages with gauze apertures of 1.5 and 2.5 mm, and only 82% in cages with the smallest apertures of 1.2 mm. But all queens in cages with larger apertures were injured, while 9% of non-injured queens were found in cages with the smallest apertures. When double gauzes with apertures 1.5 and 2.5 mm were fixed to the cages 0.75 or 1.5 mm apart, one from the other, the percentage of surviving queens decreased considerably to 64 or 27%.

However, the percentage of non-injured queens, in ratio to the original number of caged queens, was in all the cages 9%. This percentage of non-injured queens was the same as found in cages with single gauze with apertures of 1.2 mm. But in the last cages the percentage of survivals was much higher at 82%. This indicates that the conditions for queens in cages with single gauze were better than in cages with double gauzes.

The above results show that storage of queens in queen banks results in injuries of queens. When storage of several queens in a colony is unavoidable, then cages with gauze of smaller apertures of 1.2-1.5 mm should be used rather than larger apertures of 2.5 mm.

It is recommended to keep reserve queens in baby nuclei. Reserve queens also may be kept for some time in small boxes. Immediately after insemination the queens must be attended by 250-350 workers (Woyke and Jasinski 1979, 1980, 1982).

But before insemination as well as after insemination the queens may be

Table 1. Results of storage of virgin queens in cages in queenless colonies for one week.

Size of cage gauze apertures	No queens	% survived	% not injured
	July 6-13		
	Single gauze		
1.5 mm	34	92	38
2.5 mm	35	91	23
	August 16-23		
	Single gauze		
1.2 mm	11	82	9
1.5 mm	10	90	0
2.5 mm	10	90	0
	Double gauze 0.75 mm apart one from the other		
1.5 mm	11	64	9
2.5 mm	11	27	9
	Double gauze 1.5 mm apart one from the other		
1.5 mm	11	27	9
2.5 mm	11	27	9

kept in boxes or cages with a lower number of bees. The boxes or cages may be kept at room temperature, in an incubator (28°C) or in bee colonies. In the last case direct access of workers from the colony to the cages with confined queens and workers must be prevented by metallic or plastic gauze.

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