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PRACTICE ABSTRACT no. 1

Achieving mating control in honey bees

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PROBLEMS

The efficacy of breeding programs depends on efficiently implemented mating control. In breeding programs for honey bees, this key element is often missing or isn't implemented, leading to slower genetic gain (Plate et al., 2019). Even in breeding programs with implemented mating control, its efficiency is rarely measured and documented. Consequently, estimated breeding values are often unreliable, providing poor guidance in the selection process. The reasons for poor implementation of mating control are most often high colony density coupled with rigid legislation preventing practical solutions and economics.

SOLUTIONS

Implementation of any - either singly or in combination - of the four known methods of mating control in situ to accelerate the genetic gain, differing in speed of genetic gain, number of drone-producing colonies required, and technical gadgets needed.

Instrumental insemination

The most reliable method not requiring any verification of success is instrumental insemination (Cobey et al., 2013). The method requires one-time equipment purchase and practical training. The method itself offers the fastest genetic gain but requires diligent bookkeeping and planning to

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prevent loss of genetic diversity when used as the only method. Besides this technical method, three other approaches are available to beekeepers and queen breeders which are based on natural in-flight queen bee mating with multiple drones present in the environment.

Geographical isolation

The basic geographic isolation uses the features of the landscape - for example, long valleys in the mountainous landscape that provide natural barriers against the drones from three sides. Such a concept can achieve efficiency in mating control well over 80% with several drone producing colonies (DPCs) (~ 10) only, being a cost-efficient method (Tieslar et al., 2016).

Biological isolation

The second method is biological isolation suitable even for landscapes without prominent geographic features providing geographic isolation and based on dominating numbers of drones of controlled origin in the environment. This can be achieved by

i) providing a high number of DPCs (> 100) which can be expensive or

ii) cooperation with neighbouring beekeepers which are provided by queens that are sisters to those DPCs used in the queen breeding operation in question. This mode of operation is well suited to rear several thousands of queens for the market.

Temporal isolation

The third way is delaying mating flight building on the principle of temporal isolation - namely letting mating flights happen in the late afternoon/early evening when most of the foreign drones are already back in the hives. This again comes in two flavours: in first, cooling the colonies and mating nucs to manipulate the drive to engage in the mating flight. Such manipulation requires technical equipment and prevents normal foraging. The second way is to physically restrain queens and drones using a queen excluder; to prevent physical damage, a special labyrinth structure must be used at the hive entrance, to prevent light stimulation and thus keep the queen from injuries. At the same time, foragers are permitted to go about their business during the day. Both ways of temporal isolation are heavily dependent on the length of the day and the presence of foreign drones which needs to be evaluated by using the pheromone baits (Musin et al., 2022).

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BENEFITS AFTER THE INTRODUCTION

- Sustainability of production systems.
- Conservation of the local genetic pool through popularization of the local subspecies
    - Accelerating achievements of breeding goals, like productivity increase, disease resistance increase, decreased use of varroa control chemicals thus supporting organic beekeeping.

PRACTICAL INSTRUCTIONS

Method	Efficacy in achieving mating control	Additional equipment needed	Additional training needed	Number of DPC required	Recommended for
II	100 %	Yes	Yes	Low	low production
Geographic isolation	> 80 %	No	No	Low/Moderate	low/medium production
Biologic	> 70 %	No	No	High	high production
Delayed mating	> 65 %	Yes	yes	Low/Moderate	low production

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FURTHER INFORMATION

Cobey, S; Tarpy D; Woyke J. 2013. Standard methods for instrumental insemination of Apis mellifera queens. J Api Res, 52(4), https://doi.org/10.3896/IBRA.1.52.4.09

Musin E, Bienefeld K, Skerka H, Wegener J. 2021. Delayed flight time of drones and queens as a method for mating control in small-scale honey bee breeding. J Api Res, DOI: 10.1080/00218839.2021.2006983.

Plate M, Bernstein R, Hoppe A, Bienefeld K. The importance of controlled mating in honeybee breeding. Genet Sel Evol 51:75. https://doi.org/10.1186/s12711-019-0518-y

Tiesler F-K, Bienefeld K, Büchler R. Selektion bei der Honigbiene. Buschhausen Druck- und Verlagshaus, 206. ISBN 978-3-946030-45-4

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