



HYGIENIC BEHAVIOUR IN THE AQBBP JUNE 2015 UPDATE

Bee Scientifics

Hygienic behaviour of breeder and open mated colonies of the Australian Queen Bee Breeding Program after one round of hygienic selection June 2015.

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Written by Jody Gerds
beescientifics@gmail.com
www.beescientifics.com.au

Introduction

Hygienic testing for the AQBBP began in late September 2014 on 45 colonies from 14 lines of open mated queens near Launceston Tasmania in the apiaries of Lindsay Bourke's Australian Honey Products LTD PTY. The breeding stock for the open mated queens consisting of 50 colonies from the same 14 lines was then assessed in October 2014 at Dewar Apiaries owned by Laurie and Paula Dewar near Kalbar Queensland.

From the October test results, queen mothers were selected from the most hygienic colonies from each line for cell rearing to replicate the lines through artificial insemination (AI). Drones were collected from the most hygienic program colonies and used to inseminate virgin queens. Cells were also reared off of the most hygienic queens from each line to produce the next round of open mated queens for field assessment in Queensland and Tasmania. These virgins were open mated in in close proximity of the program AI breeders to benefit from the program drone pool.

The colonies headed by AI queens from the renewed breeding lines and colonies headed by the next round of open mated assessment queens were assessed for hygienic behaviour in April 2015 in Queensland. Of the breeders, 32 were located across 6 yards of Dewar Apiaries owned and 16 were located in the same yard at NT Bees owned by Graham Beech; 48 AI breeders were tested in total. All 54 open mated queens were located in one yard owned by Mal Alroy of Stinger Apiaries.

Methods

All hygienic tests were performed by the freeze kill brood assay using 10 ounces of liquid nitrogen to freeze-kill a known amount of sealed brood. Frames were replaced into their colonies and the tests were read 24 hours later. The Liberal Test which accounts for completely and partially cleaned out cells was used as an indicator of hygienic propensity with a cut off at 90% removal in 24 hours and the Strict Test which accounts for only cells that were completely cleaned in 24 hours was used to assist in breeder selection with a cut off at 95% removal. Data on presence and absence of nectar flow was recorded.

Results and Discussion

Hygienic behaviour of colonies headed by unselected and selected queens

The first round of hygienic testing of unselected colonies showed the open mated queens (Tasmania September 2014) as being less hygienic with greater within line variability than the breeders (Queensland October 2014) (Table 1). The open mated queens were tested after being fed sugar syrup with no honey flow while the breeders were tested on a honey flow (Figure 1A).

Table 1. Mean liberal hygienic behaviour of colonies headed by breeder and open mated queens with and without queen mother selection

Hygienic queen mother	Mating type	Liberal mean	Standard deviation
No queen mother selection (first round)	AI breeder	.95	.10
	Open mated	.67	.22
Yes queen mother selection (second round)	AI breeder	.91	.15
	Open mated	.86	.08

The second round of testing performed on breeder and open mated queens in Queensland in April showed a great increase in the hygienic behaviour of the open mated queens after one round of selection. However, the breeder queens scored a bit lower after the first round of selection compared to unselected colonies (Figure 1B).

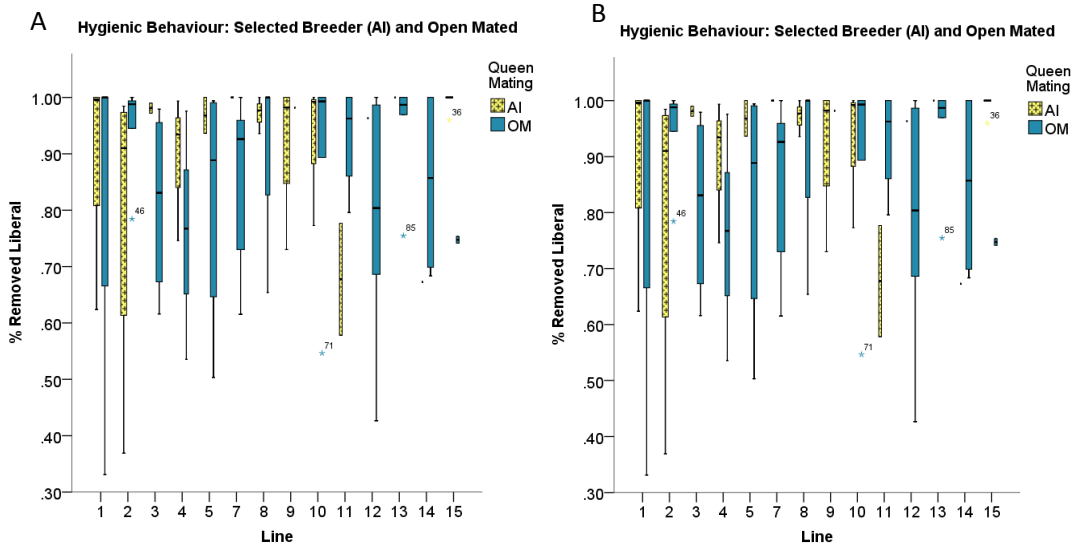


Figure 1 A. Hygienic behaviour of unselected breeder and open mated queens from the AQBBP September-October 2014 before queen or drone mother selection. B. Hygienic behaviour of open Breeder (AI) and open mated colonies that were reared from hygienic colonies from the AQBBP April 2015.

There was no significant difference in hygienic behaviour between unselected and selected AI breeders for either the liberal test ($F_{1,95} = 1.876, p > .170$) or the strict test ($F_{1,95} = 0.217, ns$). However there was a significant difference between the unselected and selected open mated colonies for both the liberal ($F_{1,97} = 22.45, p < .001$) and strict tests ($F_{1,97} = 36.49, p < .001$).

Nectar Flow

It has been reported elsewhere in the world that bees tend to be more hygienic on a nectar flow. As such, we collected data on presence and absence of a nectar flow whilst performing hygienic tests. There was a significant effect of nectar flow on liberal hygienic behaviour ($F_{1,193} = 55.78, p < .001$) irrespective of queen mating (AI $F_{1,94} = 11.303, p > .001$ and OM $F_{1,97} = 22.45, p < .001$) (Figure 2).

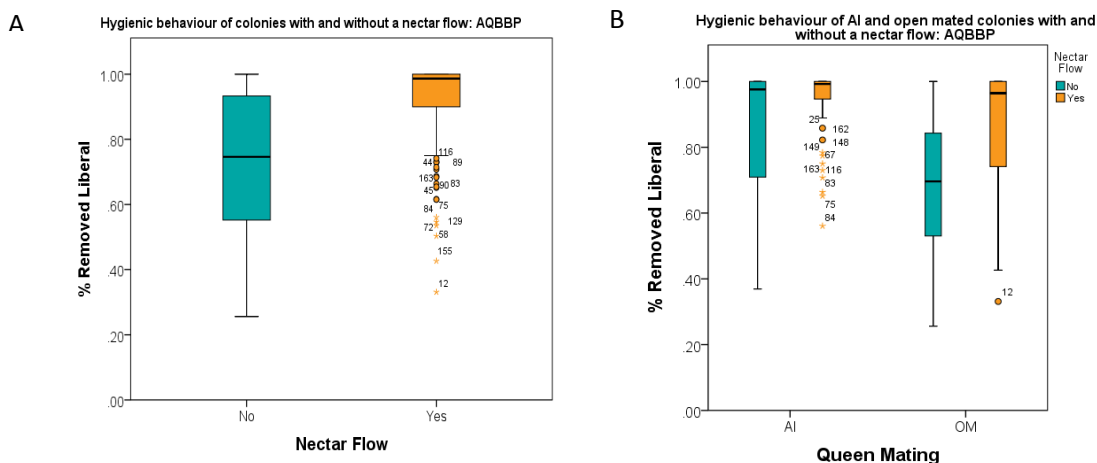


Figure 2 Liberal hygienic behaviour of colonies with and without a nectar flow A) all tested colonies in the AQBBP. B) AI and open mated queens separated.

Line Specific Information

Lines 15, 10, and 14 are the highest performing lines with respect to hygienic behaviour for both AI and open mated queens (tables 2 and 3, figures 3 and 4). Line 5 is consistently last for both the liberal and strict tests and is generally more variable than the other lines.

Table 2: Mean and standard deviation of the liberal hygienic behaviour test of both AI and open mated queens of the AQBBP. Sorted by highest mean and lowest standard deviation

LINE	Mean Liberal	Standard Deviation	Count
15	.93	.11	17
10	.90	.19	14
14	.90	.14	10
1	.88	.22	13
11	.87	.14	12
3	.87	.15	12
8	.87	.18	16
2	.84	.21	20
9	.83	.22	11
7	.83	.23	16
13	.82	.21	13
4	.81	.22	13
12	.80	.18	12
5	.77	.26	17

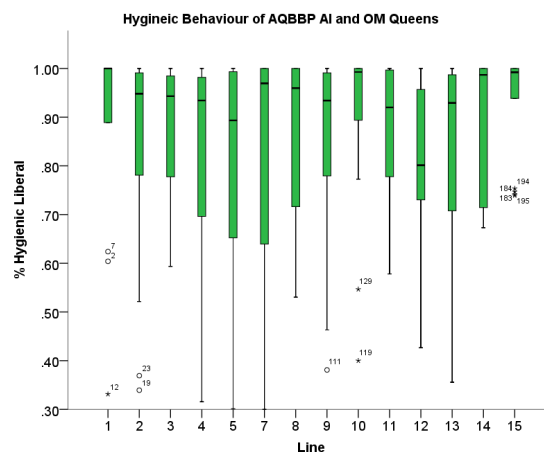


Figure 3: Liberal Hygienic behaviour of AI and OM colonies

Table 3: Mean and standard deviation of the strict hygienic behaviour test of AI breeder queens of the AQBBP. Sorted by highest mean and lowest standard deviation.

LINE	Mean Strict	Standard Deviation	Count
15	.95	.11	10
10	.93	.13	8
14	.87	.17	4
8	.86	.19	8
1	.86	.22	7
7	.85	.24	8
4	.84	.14	7
9	.84	.11	6
2	.83	.24	9
11	.82	.18	6
3	.79	.17	6
12	.78	.08	5
13	.77	.14	5
5	.74	.23	8

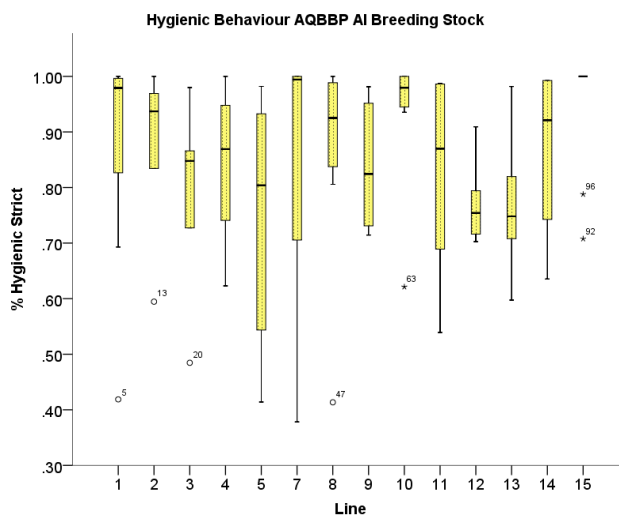


Figure 4: Strict Hygienic behaviour of AI breeder colonies

Nectar Flow, Hygienic Behaviour, and Queen Selection

The influence nectar flow has on hygienic behaviour is important to take into consideration when comparing testing rounds and between apiary tests. In general, when the bees are on a nectar flow bees are more hygienic. However, rapid hygienic behaviour is a heritable genetic trait that can be enhanced through selective breeding. Figure 5 charts the mean hygienic behaviour of colonies with and without queen mother selection with and without a natural nectar flow. On average, colonies selectively bred for hygienic behaviour are more hygienic than non-selected queens when not on a nectar flow. This is extremely important to consider because it is in the times of dearth (no nectar flow) that bees' immune systems are more taxed leaving them more susceptible to succumb to disease. Bees bred for hygienic behaviour maintain their house cleaning capability and therefore are more likely to remove diseased brood from the colony, preventing the further spread of disease.

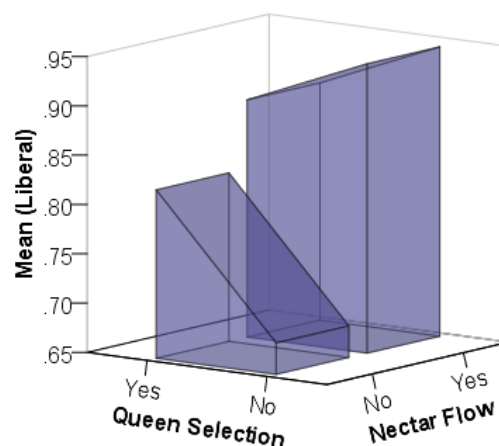


Figure 5: Mean liberal hygienic tests with and without queen selection on and off a nectar flow. Colonies selectively bred for hygienic behaviour are more hygienic while not on a nectar flow than non-selected queens

Conclusion

The hygienic behaviour exhibited by the colonies in the Australian Queen Bee Breeding program is exceptional. After a year of data collection we are beginning to see trends toward increasing hygienic behaviour of colonies headed by open mated queens after queen mother selection. We are also observing that nectar flow and potentially resource availability plays an important role in contributing to the hygienic behaviour of a colony. This information will help us compare the data from apiary to apiary and from year to year.

These hygienic testing results are quite promising for the furthered development of hygienic stock in Australia. However, it is essential to understand that only 50% of the drones need to be from hygienic colonies for the trait to be expressed in the next generation. It is therefore crucial to remain focused on other beekeeper desired traits such as disease resistance, honey production and gentleness by keeping exceptional colonies in the breeding program despite their hygienic test results. Additionally, investigating the influence of hygienic behaviour on pest and disease prevalence and severity would be of benefit to industry.

Support

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