



Drone viral infection, immunity and flight performance

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Introduction

- ❖ Good flight ability is essential for successful drone mating in *Apis mellifera*.
- ❖ Mating flight is energetically costly and may be hindered by pathogen load.
- ❖ Viruses such as deformed wing virus (DWV) have been detected in the reproductive organs of sexually mature drones, with potential transmission through natural mating or artificial insemination.
- ❖ However, the impact of these viral infections on drone flight performance is still unknown.

Aim

To evaluate the impact of natural viral infection on the flight ability of drones from three age cohorts.



Methods

1. Rearing drones in 3 colonies



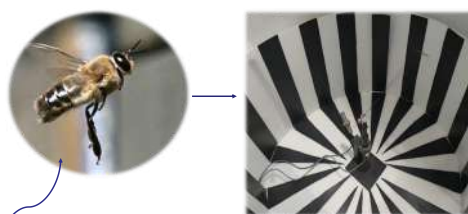
2. Marking emerging drones



3. Sampling drones at three ages

Day: 7
 Day: 14-15 (sexually mature)
 Day: 20-21

4. Flight test using the flight mill



5. Virus and Immunity Assessment



a. Viral load

DWV-A

DWV-B

IAPV

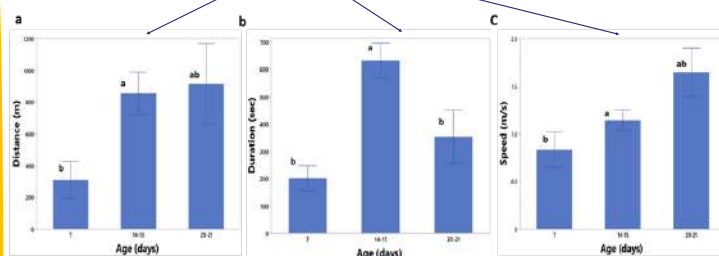


Rt-qPCR

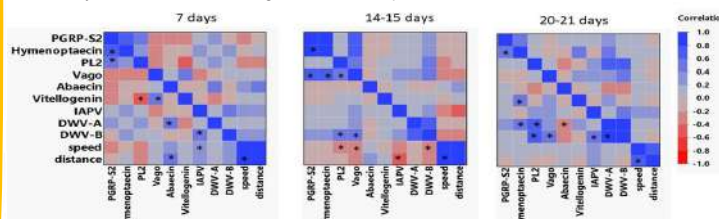
b. Expression level of immune genes from different pathways

- Peptidoglycan recognition protein S2 (PGRP-S2)
- Protein lethal 2 (Pl2)
- Abaecin
- Vago
- Vitellogenin
- Hymenoptaecin

Flight Distance, Duration and Speed of drones by age

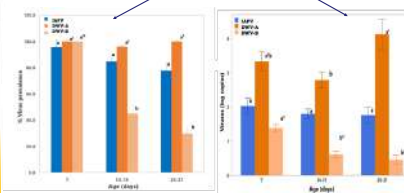


Sexually matured drones flew longer distances compared to immature drones.



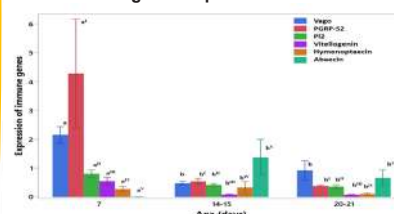
*-significant correlation (Pearson, $p < 0.05$).

Virus Prevalence and Loads



Drones were infected by the 3 tested viruses. DWV-A was the dominant and its loads increased as DWV-B loads decreased with age. There was no significant change in IAPV loads with age.

Immune genes expression in drones



Expression of the immune genes changed as the drone aged.

Conclusions

- ❖ Flight ability in drone was age-dependent
- ❖ Flight distance and speed were negatively correlated with loads of IAPV and DWV-B, respectively, in sexually matured drones
- ❖ Flight speed was negatively correlated with the expression of immune genes Pl2 and PGRP-S2 in sexually matured drones.
- ❖ Our findings suggest effect of viral infection on drone flight and a possible trade-off between drones' flight ability and their immunity

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Drones' flight performance is the paramount for their mating success in honey bees. Mating flight is energetically costly and may be hindered by biotic and abiotic factors. Using the flight mill, we assessed the flight ability of drones from three age cohorts (one, two and three weeks old). Then we subsequently examined their sexual maturation, viral infection by deformed wing viruses type A and B (DWV- A, DWV-B) and Israeli acute paralysis virus (IAPV) as well as expression of six immune genes by RT-qPCR. Sexually mature drones flew longer distances compared to immature drones. Though DWV-A and IAPV infections were common in drones, their impact on drone flight differed. Interestingly, flight distance and speed were negatively correlated with loads of IAPV and DWV-B respectively in 14-15 days old drones, but not in 7 days old. Flight speed was negatively correlated with the expression of protein lethal 2 (Pl2) and peptidoglycan recognition protein S2 (PGRP-S2) in 14-15 days old drones. Our findings suggest effect of viral infection on drone flight and a possible trade-off between drones' flight ability their immunity. Deepening our understanding of drone mating success and its relation to their health status is an important step for the success in breeding efforts for honey bee health.