Possible influence of landscape structure on homing flight duration of honey bees after pesticide exposure

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Introduction

This experiment was part of an international homing flight ring-test. The goal of this study was to validate a method to determine the effects of subletal doses of pesticides on the homing flight of forager honey bees (*Apis mellifera* L.) using RFID (radio-frequency identification).

Our hypothesis, different landscape (urban and rural) might affect the cognitive orientation capacity[1], hence could amplify a treatment effect on the duration of homing flight. Therefore, the tests were conducted under similar conditions in two different settings (urban and rural) to investigate any potential impact on the results of the experiment.

Method

According to the ring-test protocol, forager bees were collected from the hive entrance and powdered with pink hydrophobic powder in the morning. They were released one kilometre away from the hive and captured again when arrived at their hive. Afterwards a tag was glued on the dorsal part of the thorax (fig. 1). Bees were orally exposed to different subletal concentrations of the insecticide thiamethoxam (0.1, 0.3 or 1 ng/bee) and an untreated control (30% sucrose soln.) was added. After exposure, the bees were released at the same spot as previously in the morning. Each hive entrance was equipped with four RFID-readers[2] (fig. 2) which registered the time of each bee returning and passing the readers.

Fig. 1: Bee in a queen marker tube with tag on thorax

Fig. 2: Entrance board equipped with RFID-readers

Six runs were conducted between May and June 2016, three in each location Liebefeld (urban landscape, fig. 3) and Liebewil (rural landscape, fig.4). Distance between both locations was approx. 5 km.

Fig. 3: Liebefeld (564 m.a.s.l.)

Fig. 4: Liebewil (671 m.a.s.l.)

Results

Mean return rate in both locations was 94% (79 – 100%) for all treatments. In both locations the homing flight duration from bees exposed to the highest dose (1 ng/bee) of thiamethoxam was statistically significantly higher when compared to the others (fig. 5).

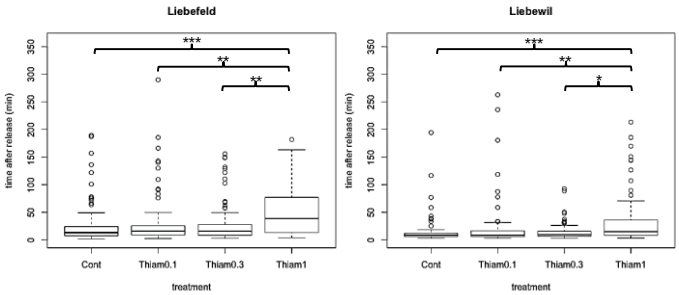

Fig. 5: Homing flight duration (min) of bees exposed to different treatments in Liebefeld and Liebewil for the first six hours.
*= p < 0.05, **= p ≤ 0.01, ***= p ≤ 0.001 (Kruskal-Wallis).

The mean homing flight durations in Liebefeld of all treatments were statistically significantly higher when compared to Liebewil (fig. 6), while the air temperatures after bee release for both sites were comparable (Liebefeld: 22.5 – 25.0 °C, Liebewil: 24.7 – 28.5 °C)

Homing flight duration (min)			
Treatments	**Liebefeld (mean ± s. d.)**	**Liebewil (mean ± s. d.)**	**significant**
Control	27.2 ± 7.0	14.6 ± 3.3	**
Thiam0.1	31.1 ± 3.9	21.9 ± 3.8	**
Thiam0.3	28.5 ± 8.9	14.8 ± 2.2	*
Thiam1	51.9 ± 4.8	36.3 ± 19.3	*

Fig. 6: Averages of the homing flight duration (min) at the two locations for each treatment for the first six hours.
*= p < 0.05, **= p ≤ 0.01 (Kruskal-Wallis).*

Conclusions

Our data shows that landscape might have an impact on the cognitive orientation capacity, hence play a role in the duration of the homing flight. Potentially urban landscape provides more obstacles than the rural which most likely resulted in a longer homing flight duration. However, in both locations the differences between the treatments were similar which supports the validity of the tested method.

REFERENCE [1]Southwick E. E. et al. (1995); [2]Van Geystelen A. et al. (2015)
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