

**THERMAL RESPONSE OF HONEYBEE WORKERS TO
TEMPERATURE MANIPULATION OF SEALED BROOD
(*APIS MELLIFERA CARNICA*)**

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A b s t r a c t

Honeybees maintain a broodnest temperature of 35°C (Hess 1926). Thermoregulatory behaviour of individuals includes heat production with flight muscles (Esch 1960).

In a queenright colony (about 2000 bees in a two-frame observation hive) a part of sealed worker brood was cooled from behind. The glass covering the brood area was replaced by infrared-transparent film. Cell walls on the opposite side of the comb were removed. A hollow metal block (5x2.9cm) was attached to the middle wall in the centre of the brood area (9x9cm). Workers were not allowed to reach this side of the brood. Water with changeable temperature (manipulation temperatures $T_M = 15, 20$ and 35°C) was pumped through the metal block. Thermographic recordings (Radiance PM) of the brood area were videotaped during each manipulation (30minutes). Still images were digitised every two minutes and thoracic temperatures (T_{Th}) of the bees were calculated with camera-specific computer software. We found differences in T_{Th} of bees in the manipulated (14.5cm²) and in the surrounding non-manipulated brood area (58.5cm²).

Manipulated brood area:

Mean T_{Th} of workers increased after begin of manipulation. At low T_M , the percentage of bees with $T_{Th} > 35^\circ\text{C}$ increased (data from 15 still images each):

$T_M = 35^\circ\text{C}$	40.6% (n=183)
$T_M = 20^\circ\text{C}$	53.0% (n=107)
$T_M = 15^\circ\text{C}$	66.2% (n=139)

During manipulation the highest means of T_{Th} (1 image each) were:

$T_M = 35^\circ\text{C}$	$T_{Th} = 35.3 \pm 2.3^\circ\text{C}$ (n=14)
$T_M = 20^\circ\text{C}$	$T_{Th} = 37.3 \pm 3.5^\circ\text{C}$ (n=14)
$T_M = 15^\circ\text{C}$	$T_{Th} = 39.3 \pm 3.1^\circ\text{C}$ (n=11)

Number of workers did not change significantly within each manipulation (t-Test, $p < 0.05$).

Non-manipulated brood area:

Percentage of bees with $T_{Th} > 35^{\circ}\text{C}$:

39.8% ($T_M = 35^{\circ}\text{C}$, $n=287$), 44.1% ($T_M = 20^{\circ}\text{C}$, $n=320$), 48.7% ($T_M = 15^{\circ}\text{C}$, $n=351$).

During manipulation the highest means of T_{Th} were:

$T_M = 35^{\circ}\text{C}$ $T_{Th} = 35.6 \pm 2.8^{\circ}\text{C}$ ($n=50$)

$T_M = 20^{\circ}\text{C}$ $T_{Th} = 36.8 \pm 2.2^{\circ}\text{C}$ ($n=41$)

$T_M = 15^{\circ}\text{C}$ $T_{Th} = 36.7 \pm 2.6^{\circ}\text{C}$ ($n=49$)

We conclude that honeybees are able to detect the need for local warming and to adjust their thermal response to the intensity of cooling.

Keyword: broodnest, temperature.