Kaolin as inert material in bio-pesticide formulations supplements the hazard to useful insects

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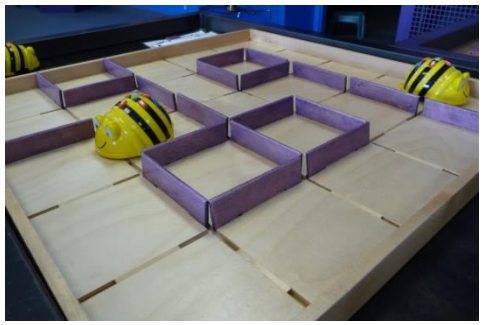
Pesticide studies

- Field exp
- Semi-field exp
- Mortality tests
- Behavioural exp
  - Learning
  - Choice
  - PER
  - …
- Physiological exp
  - Dissection
  - In-vivo?

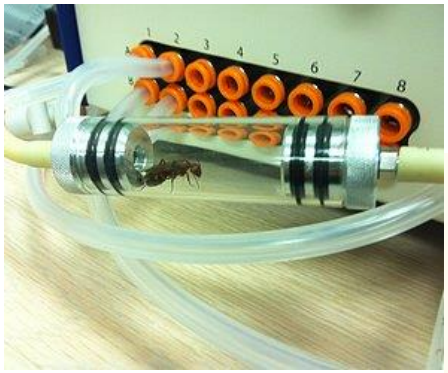


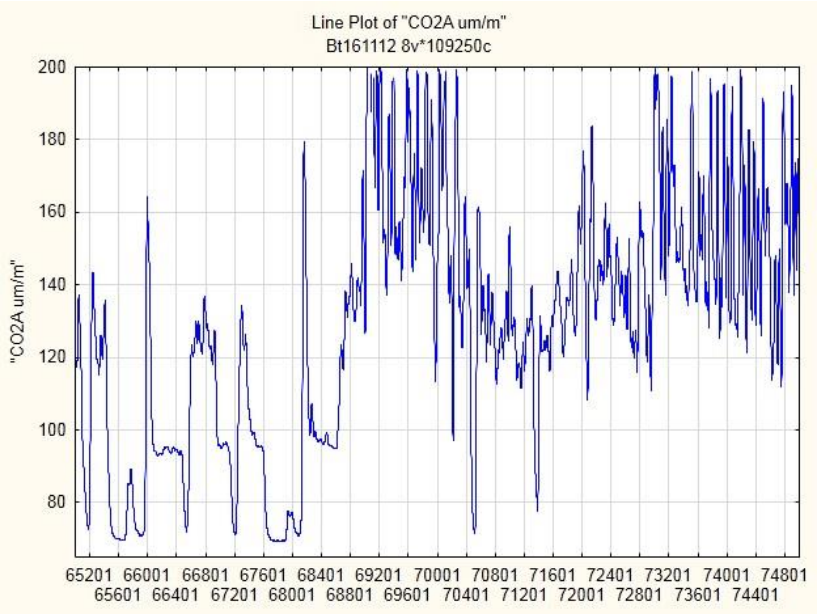


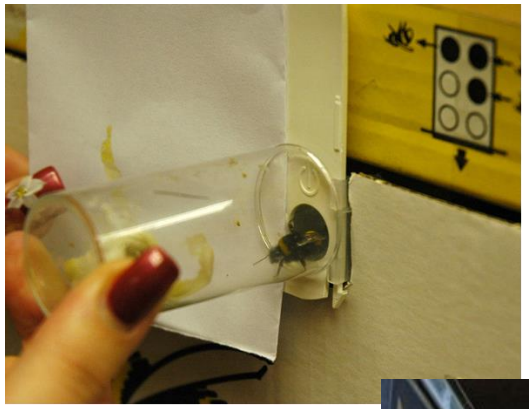


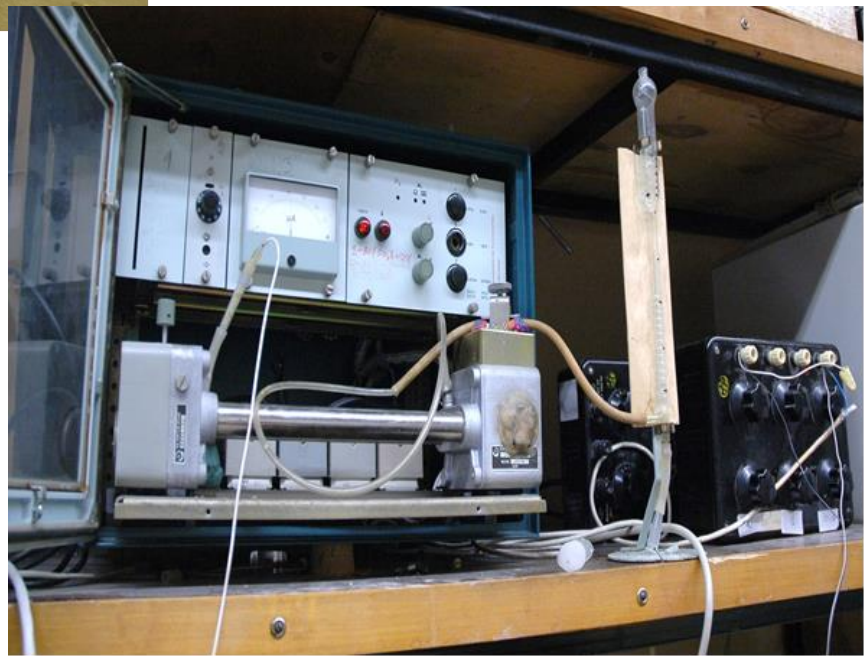

Respiration

- Reflects the metabolic rate of the organism
- Easily vulnerable system







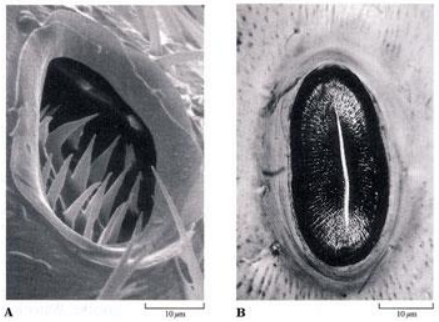


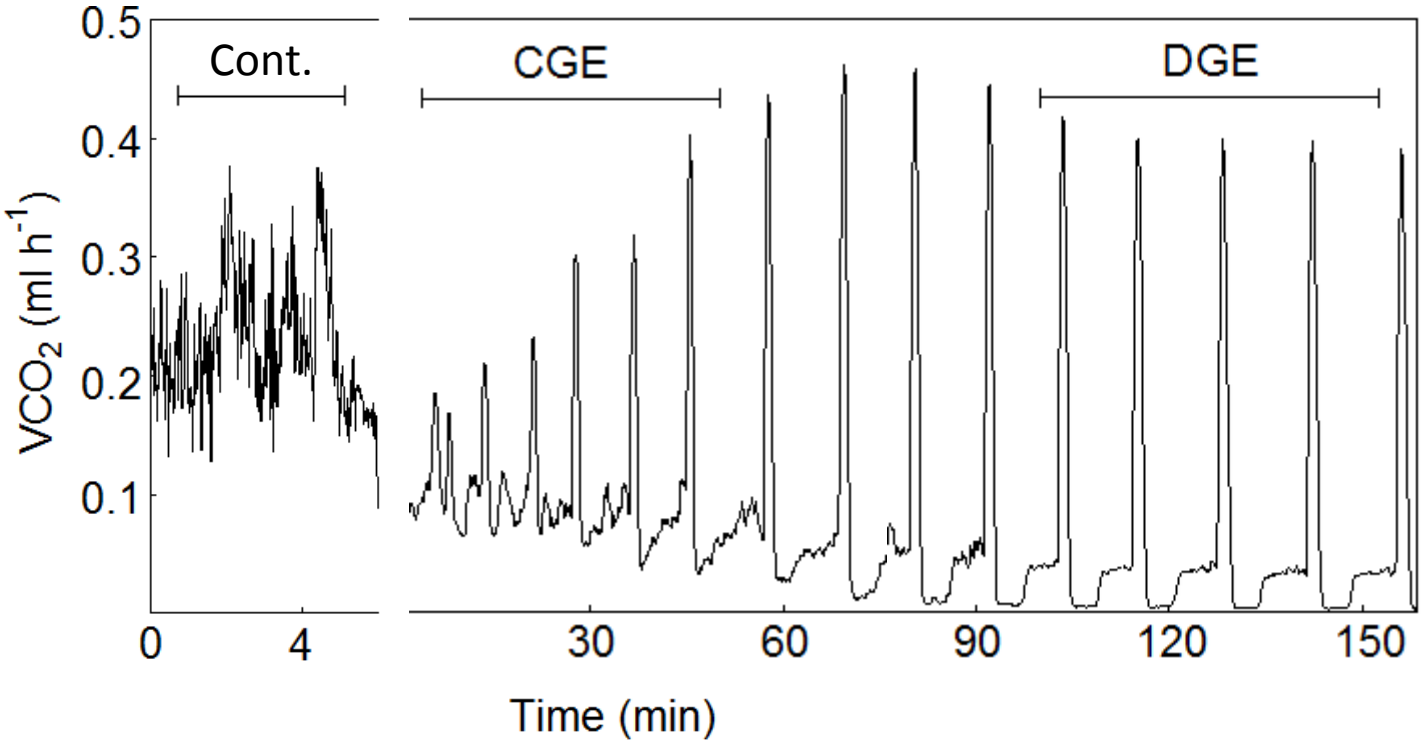
MR and respiratory patterns

Continuous (Cont.)

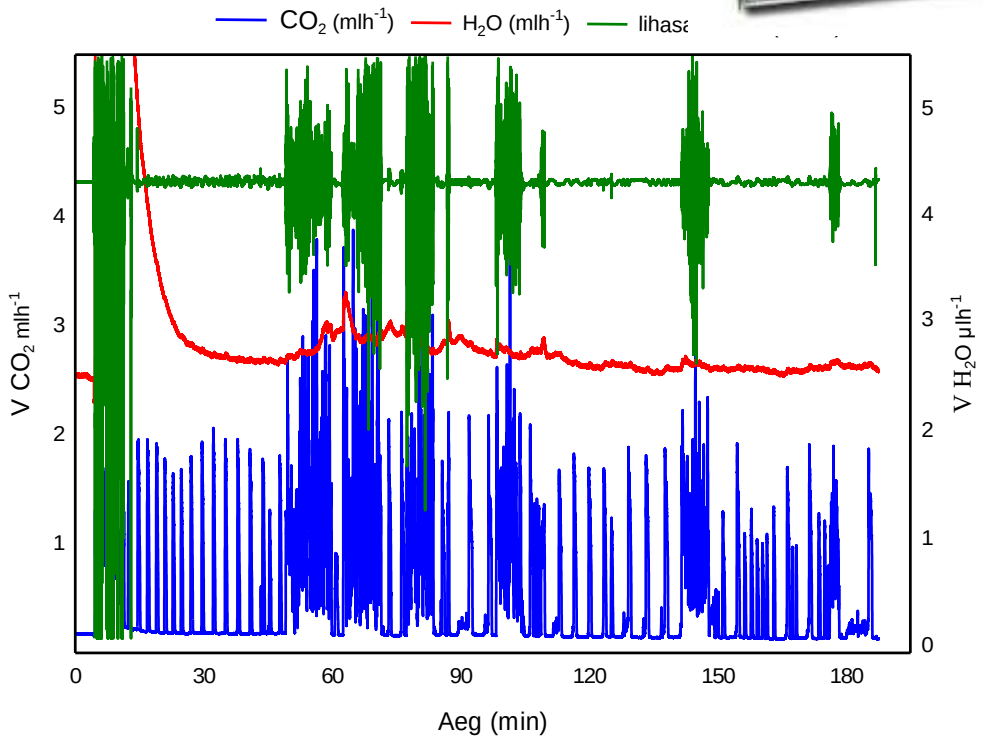
Cyclic (CGE)

Discontinuous (DGE)





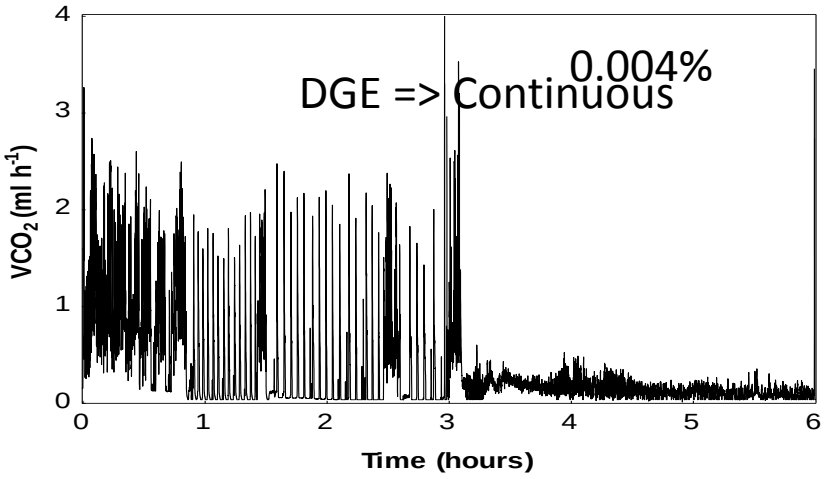
- Flow through respirometry: LI-7000 CO_2/H_2O analyzer combined with IR-actography
  - Metabolic rate
  - Respiratory rhythms
  - Water loss rate

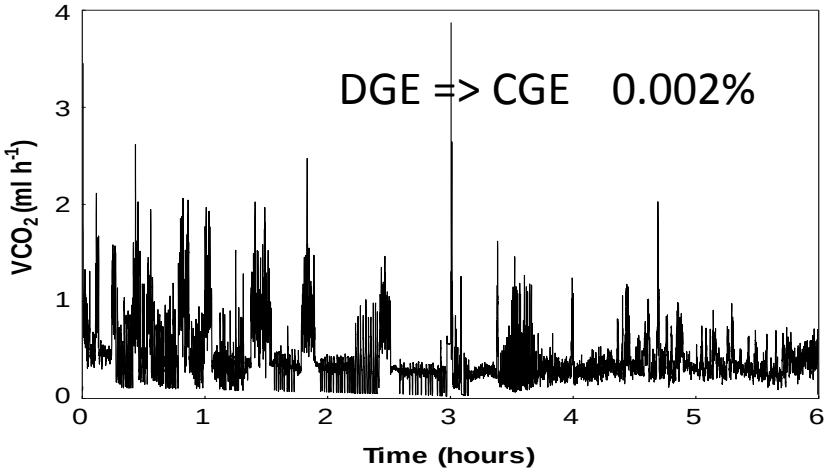


Neurotoxic effect

LD50 = 0.059 mg/bee

Contact action: alpha-cypermethrin

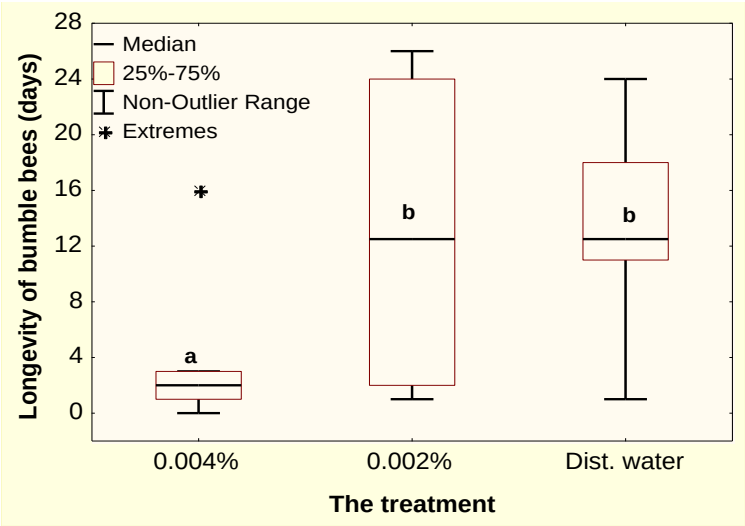




Dipping in water solution of Fastac 50EC for 10 sec

0.004%: obtained 0.099 µg/bee

0.002%: obtained 0.087 µg/bee



Entomovector technology

- New method
- Uses powdery biopreparations
- Decreases the amounts of preparations needed
- Must be safe
  - Plant products
  - Vectoring insect
  - Insect products (honey)

Kaolin

- Kaolin powder
  - Used against stored product pests
  - Causing respiratory failure?
  - Changing cuticule properties?
- Kaolin particle film
  - Physical barrier/deterrent
  - visually or tactilely unrecognizable as a host
- Kaolin is frequently used as inert materials in bio-preparations

Our experiment

Are kaolin and powdery formulations affecting bumble bee physiology?

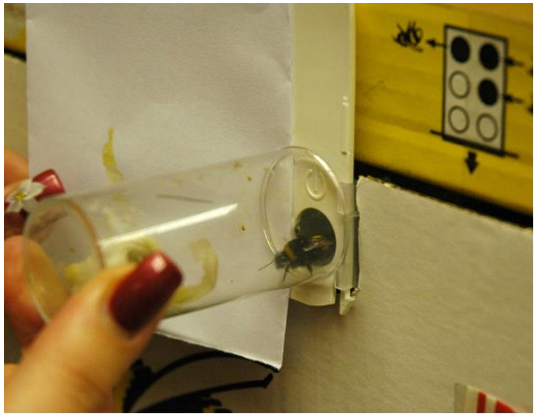
- Bumble bees: Koppert Biological Systems
- Treatments:
  - Kaolin
  - Prestop Mix (*Gliocladium catenulatum*)
  - BotaniGard (*Beauveria bassiana*)
  - Wheat flour
  - Blank treatment for control

Single treatment, immediate effect (N = 6; 18 °C)

- Immediate effect on metabolic rate and water loss rate (measured 3 h before and 3 h after the treatment)
- Effect on cuticular and respiratory WL

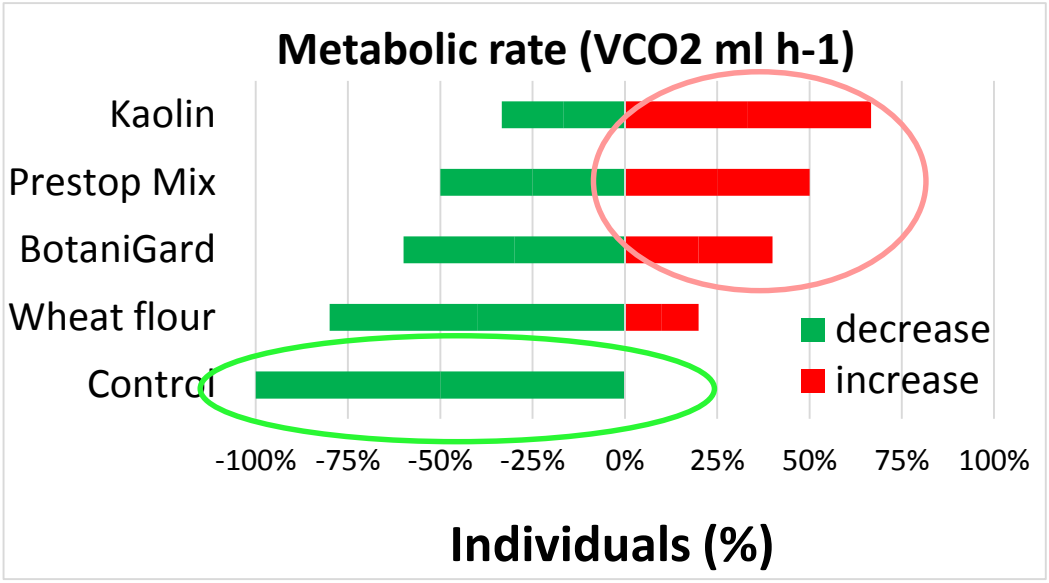
Single treatment, long term effect

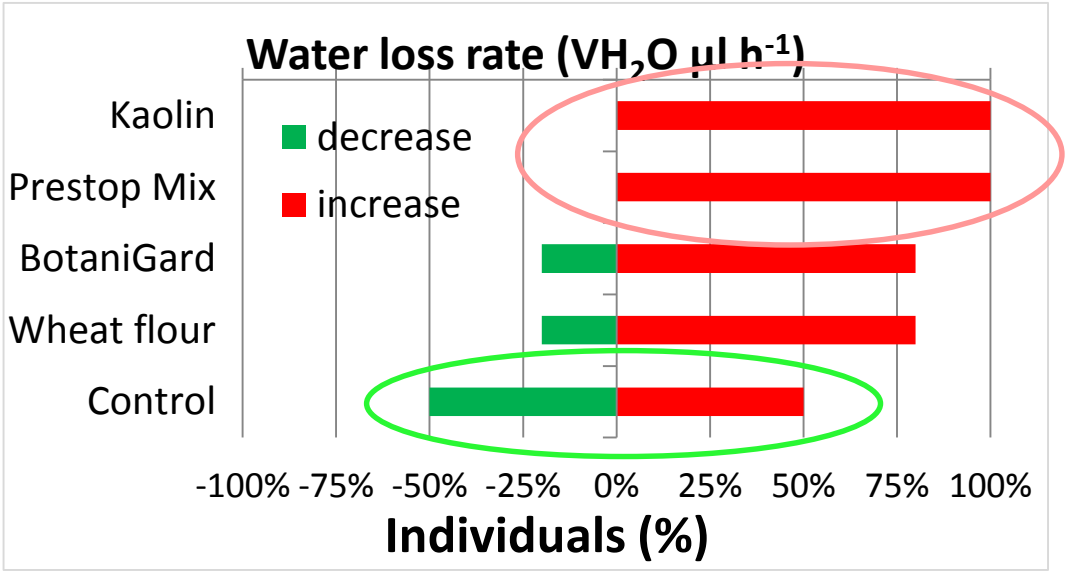
- Effect on mortality (N = 20; 18 °C and 28 °C)



Results

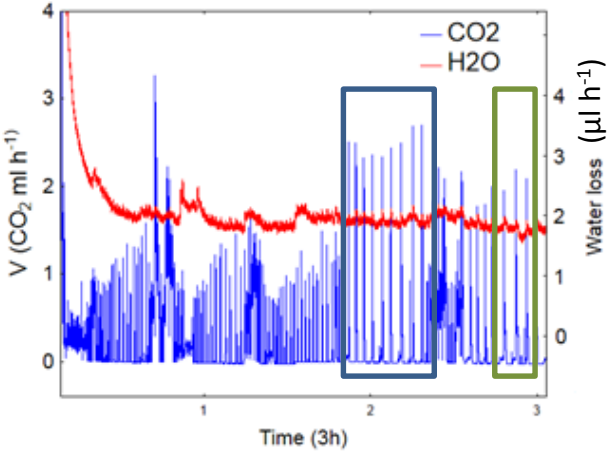
- MR normally decreases during long observation
- Powders have capacity to prevent calming process
- Normally water loss is not changing or changing a few
- Kaolin and Prestop Mix caused significant increase in WL rate

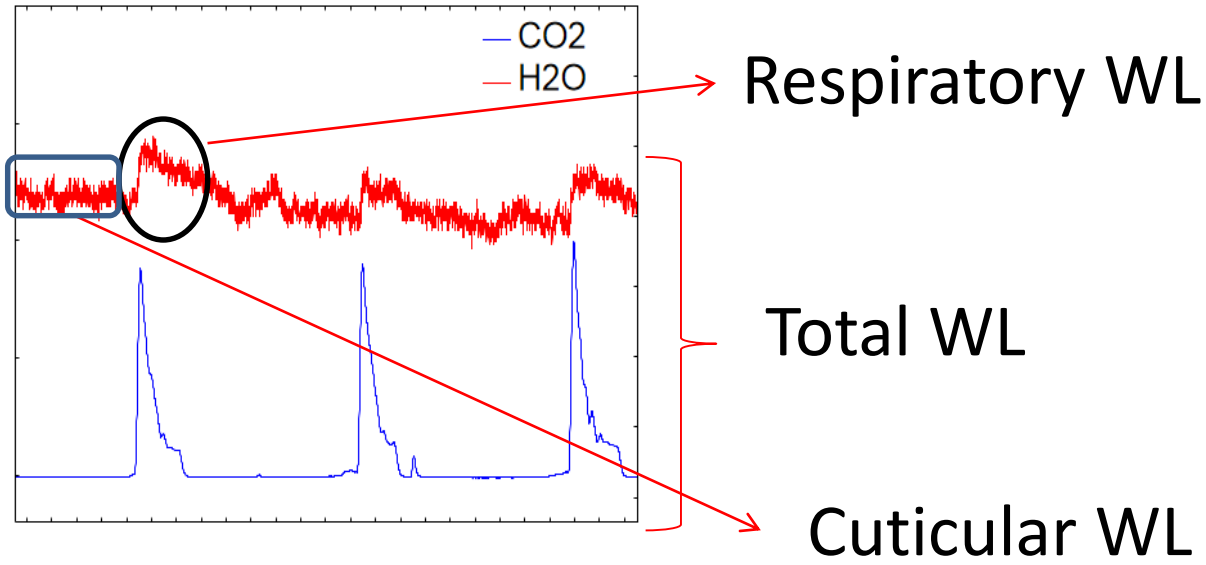




Respiratory and Cuticular WL

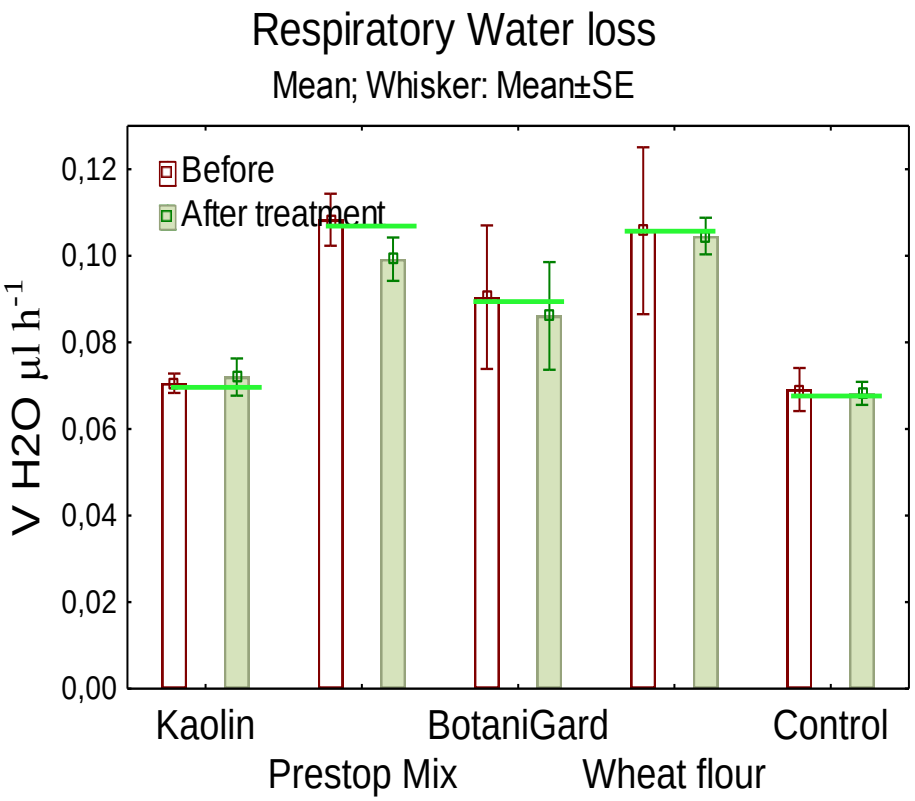
- Can be measured during the periods of DGE
- We calculated mean respiratory and cuticular WL of 3 consecutive cycles of DGE

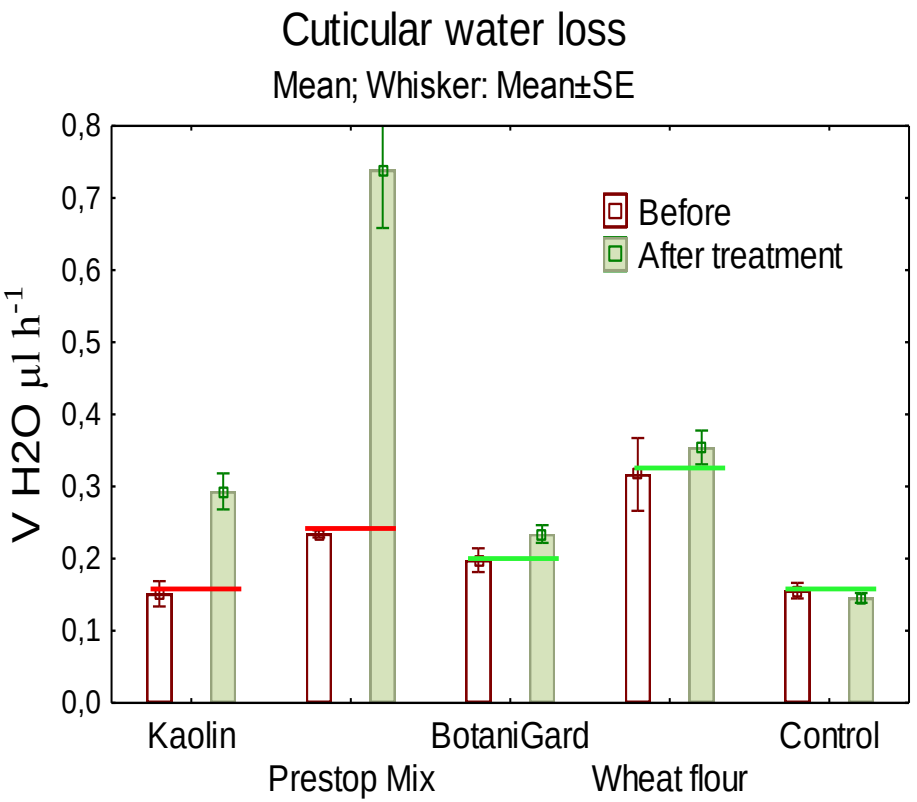




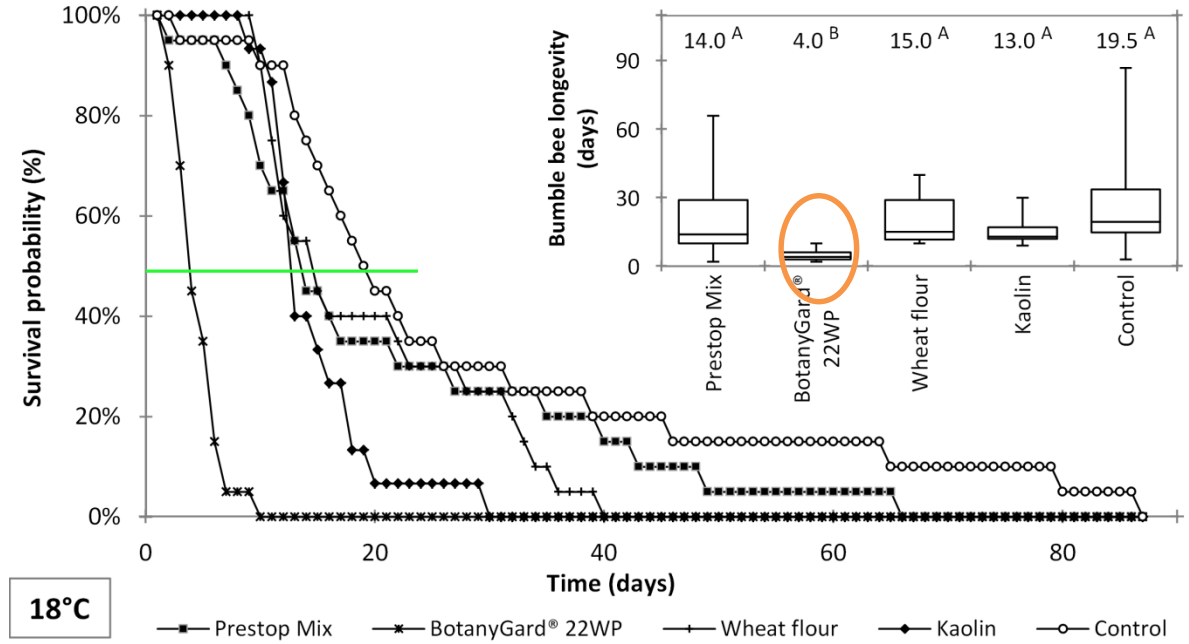
Respiratory WL = Total WL – Cuticular WL

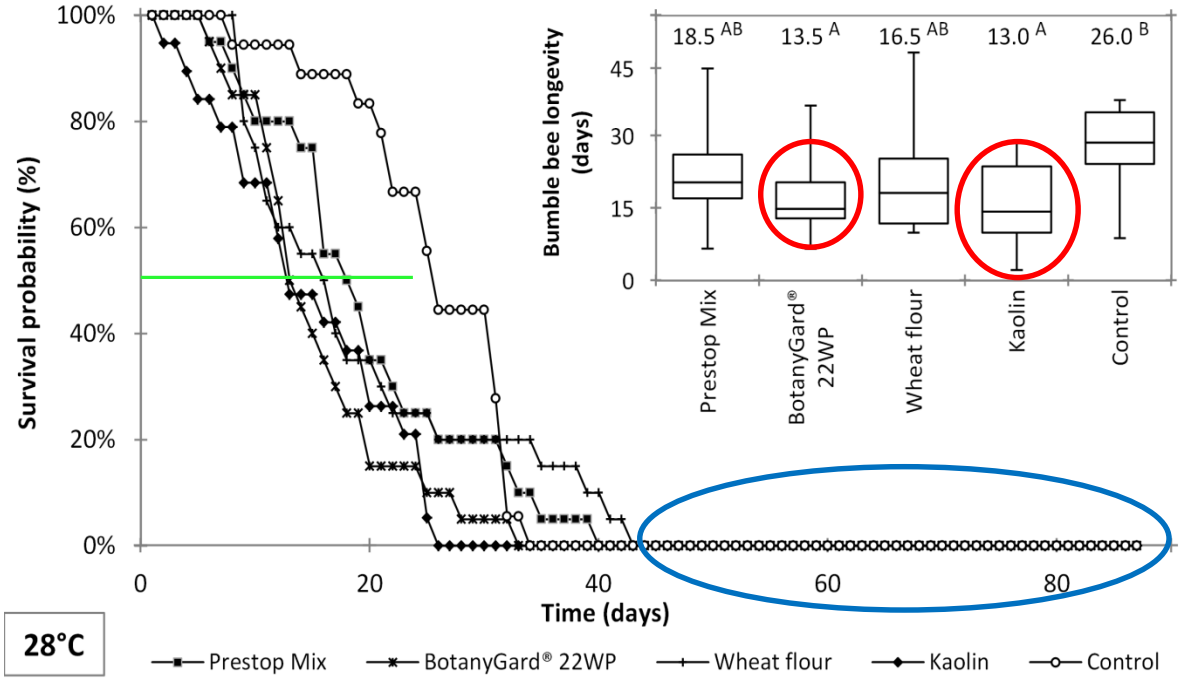
- No difference in the mean Total WLR during DGE
- No difference in mean Respiratory WL
- Significant differences in cuticular WL
  - Kaolin and Prestop Mix





The longevity





- Median longevity shorter at 18 °C

  *** BotaniGard

- Maximum longevity shorter at 28 °C

- At 18 °C only **BotaniGard** differed significantly

- At 28 °C **BotaniGard** and **kaolin** differed significantly

Conclusions

- Kaolin increases permeability of insect cuticle to water vapour
- This may affect the survival of individuals
- The testing inert materials is not obligatory
- Yet these might pose risks to pollinators or vectoring insects
- Physiological methods, for instance respirometry, can be one way to discover sub-lethal effects of pesticides or other stressors