Deformed wing virus (DWV) and *Varroa*

Is DWV the last man standing?

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With Emily Remnant, Niklas Mather, Thomas Gillard and Boris Yagound

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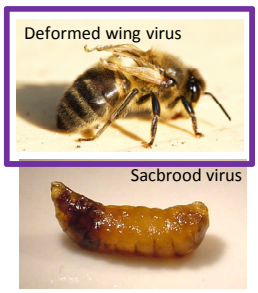
Bee Viruses

- ~ 24 known viruses
  - Australia has ~5
- Seasonal outbreaks, usually mild
- Normally transmitted by feeding, trophallaxis

T. M. Fraser

H. Heilmann



Deformed wing virus
DWV

- Not known to occur in Australia
- Almost always mentioned in the same sentence as '*Varroa*'
- While a generalist insect virus, named after its effect on bees

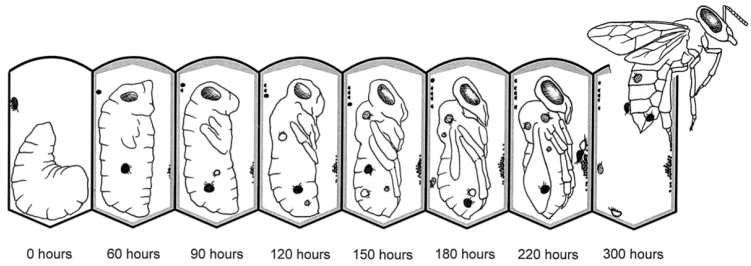
Viruses have changed

Varroa destructor

Jumped from *A. cerana* → *A. mellifera*

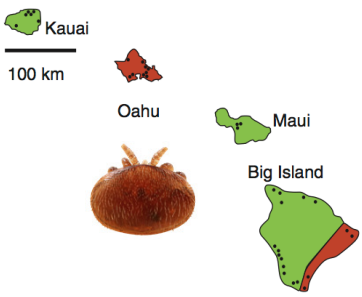
Impact of *Varroa*

- Wounding
  - Damage to the cuticle
  - Suck haemolymph (bee blood)
- Vector for viruses
  - Spread viruses
  - Viruses increase in mites



Island-hopping *Varroa*

- Hawaii, 2009:
  - *Varroa m*ite distribution limited;
  - Deformed wing virus (DWV) levels low
  - Multiple Deformed wing virus strains present
- Hawaii, 2012:
  - *Varroa* spread, colonies collapsing
  - Rapid increase in Deformed wing virus levels
  - Only one Deformed wing virus strain present



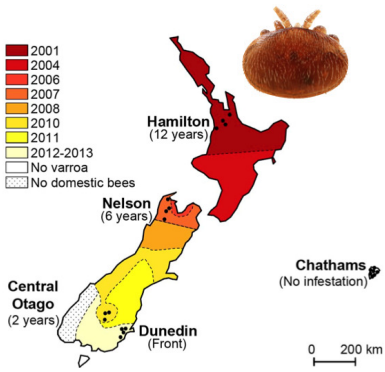
Global Honey Bee Viral Landscape Altered by a Parasitic Mite

Stephen J. Martin,[1]* Andrea C. Highfield,[2] Laura Brettell,[1] Ethel M. Villalobos,[3] Giles E. Budge,[4] Michelle Powell,[4] Scott Nikaido,[3] Declan C. Schroeder[2]*

8 JUNE 2012 VOL 336 SCIENCE

Island-hopping *Varroa*

- New Zealand
  - North Island: 2000
  - Spread over 10 years
  - Deformed wing virus levels dramatically increased



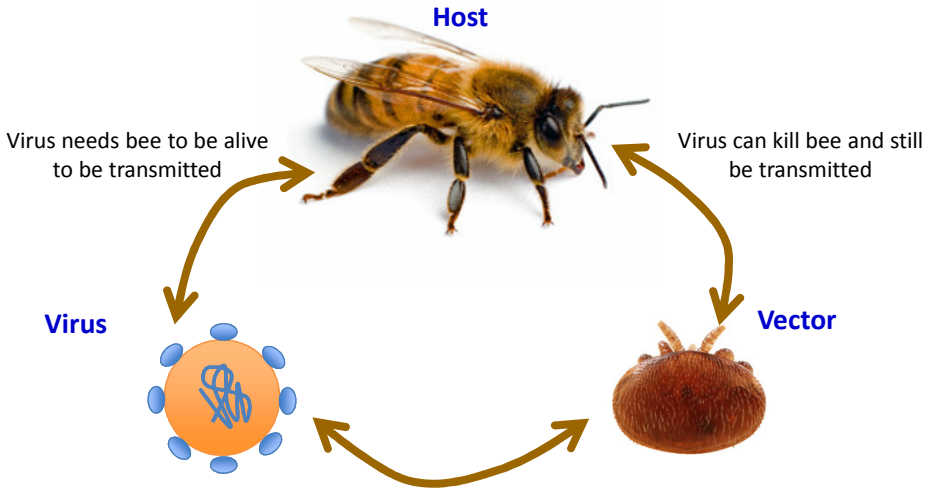
On the Front Line: Quantitative Virus Dynamics in Honeybee (*Apis mellifera* L.) Colonies along a New Expansion Front of the Parasite *Varroa destructor*

Fanny Mondet[1,2,3]*, Joachim R. de Miranda[4], Andre Kretzschmar[5], Yves Le Conte[2], Alison R. Mercer[1]

1 Department of Zoology, University of Otago, Dunedin, New Zealand, **2** INRA, UR 406 Abeilles et Environnement, Avignon, France, **3** AgroParisTech, Paris, France, **4** Department of Ecology, Swedish University of Agricultural Sciences, Uppsala, Sweden, **5** INRA, UR 546 Biostatistique et Processus Spatiaux, Avignon, France

Host- virus- vector interaction

Vectors can change virus infections



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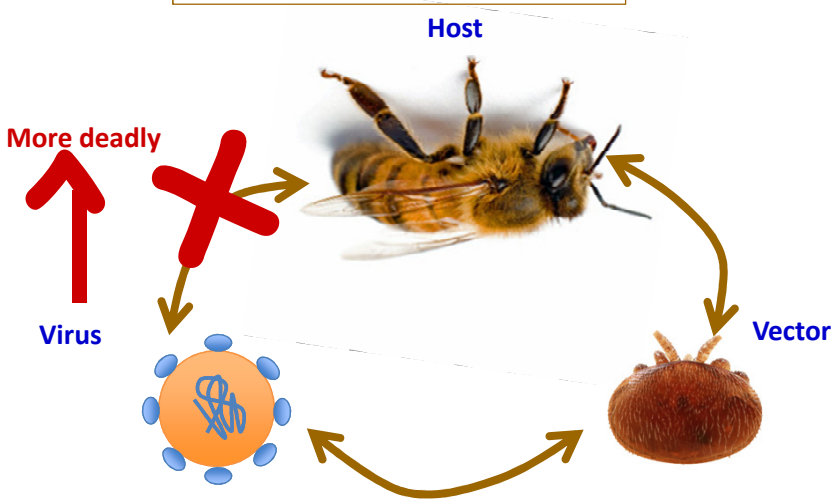
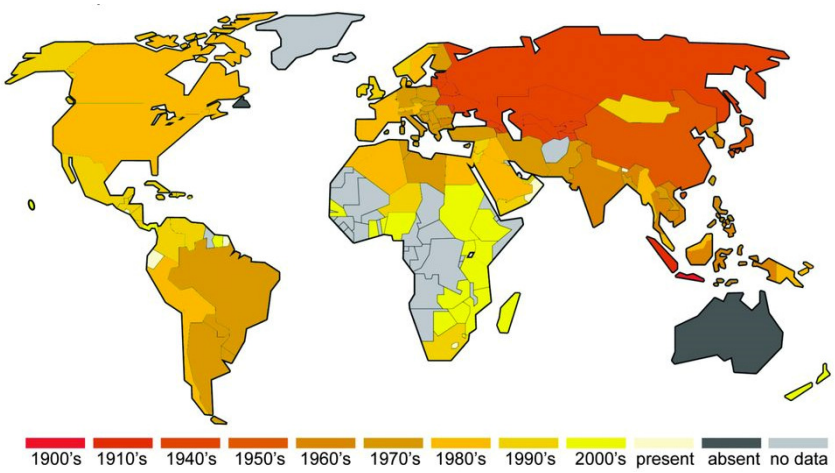


Wherever *Varroa* arrives, DWV increases

Global distribution of Varroa



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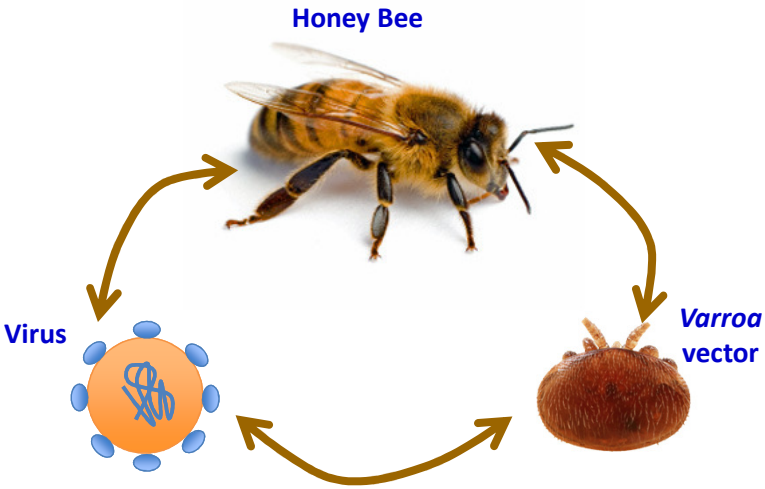
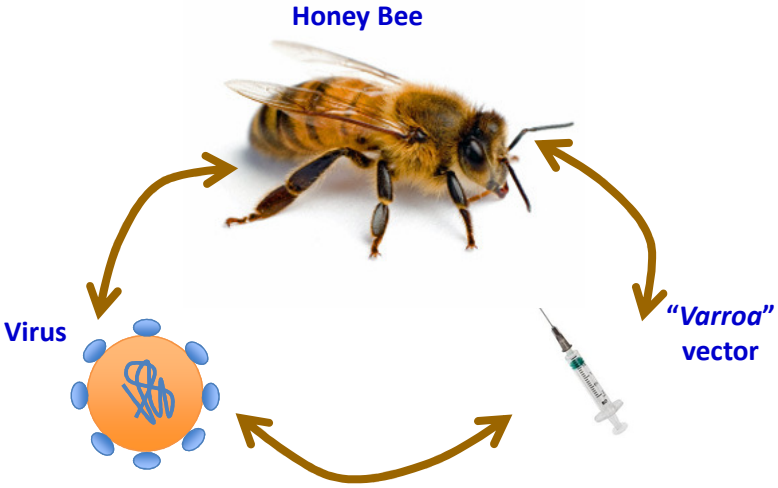
Wilfert *et. al,* (2016) Deformed wing virus is a recent global epidemic in honeybees driven by *Varroa* mites. Science **351**(6273), pp. 594-7

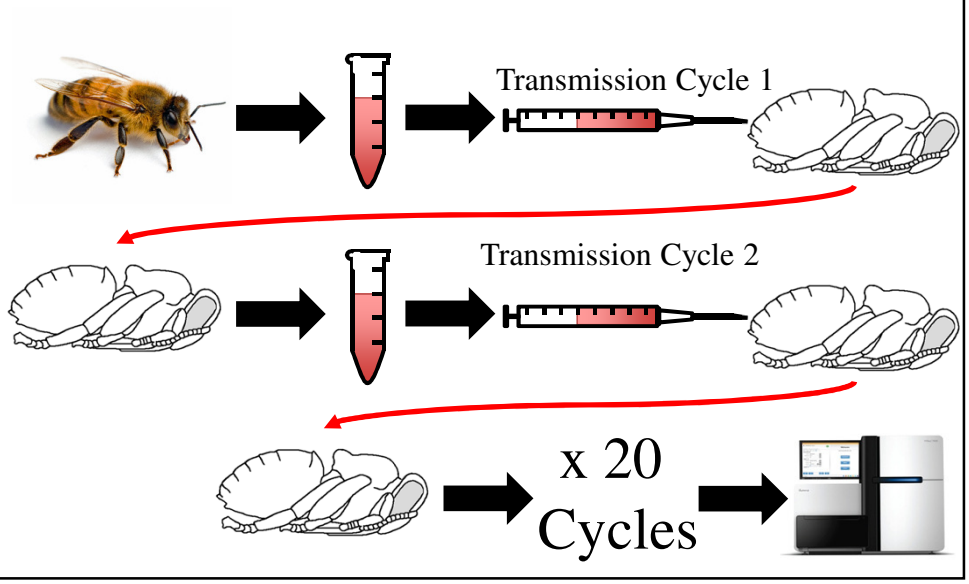
What exactly is the relationship?



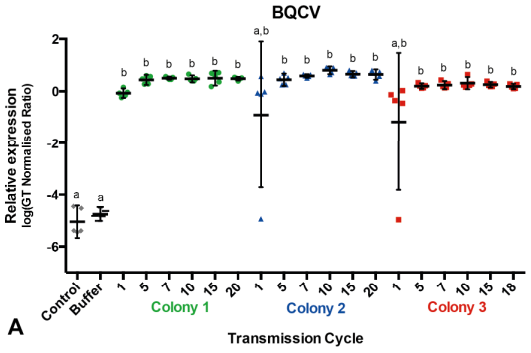
Pretending to be a *Varroa* mite



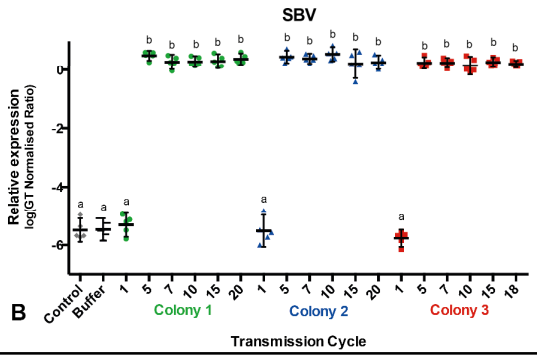
Serial transmission experiment



Measure of amount of virus present



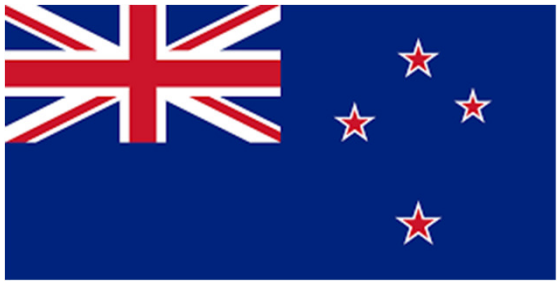
Black Queencell Virus
Immediate increase



Sacbrood Virus
Increase after cycle 1

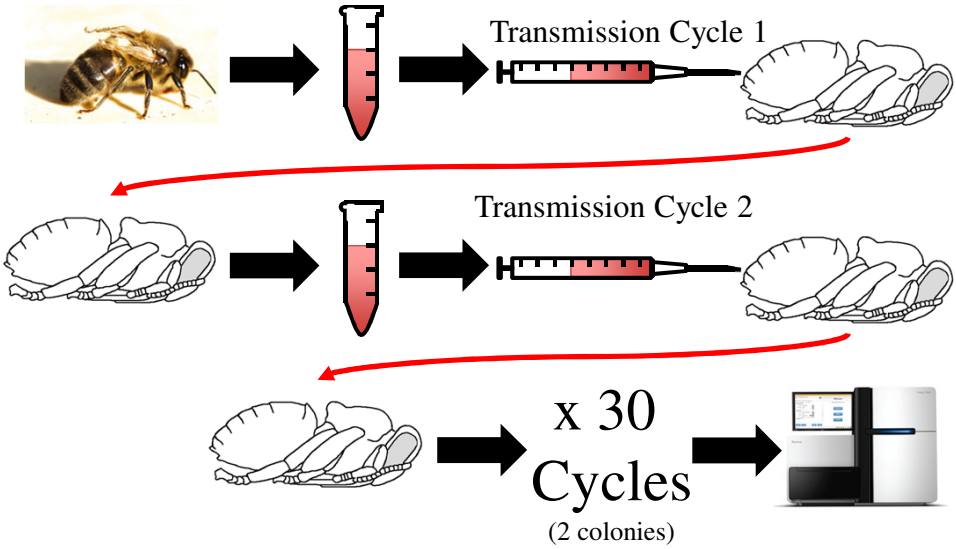
Injecting haemolymph from bee to bee increases the virus levels of two common honeybee viruses

Serial transmission experiment - DWV

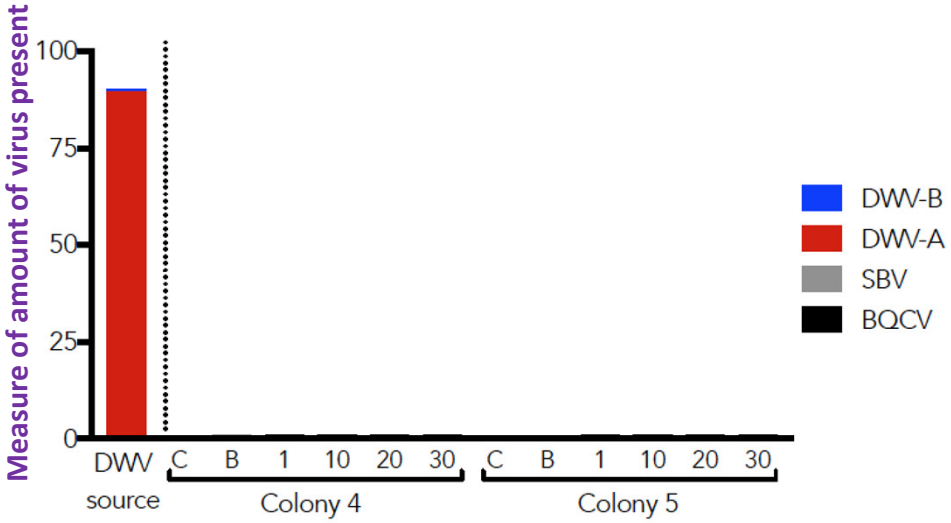


Importation of frozen bees permitted under our Department of Agriculture and Water Resources import permit number 0000917783

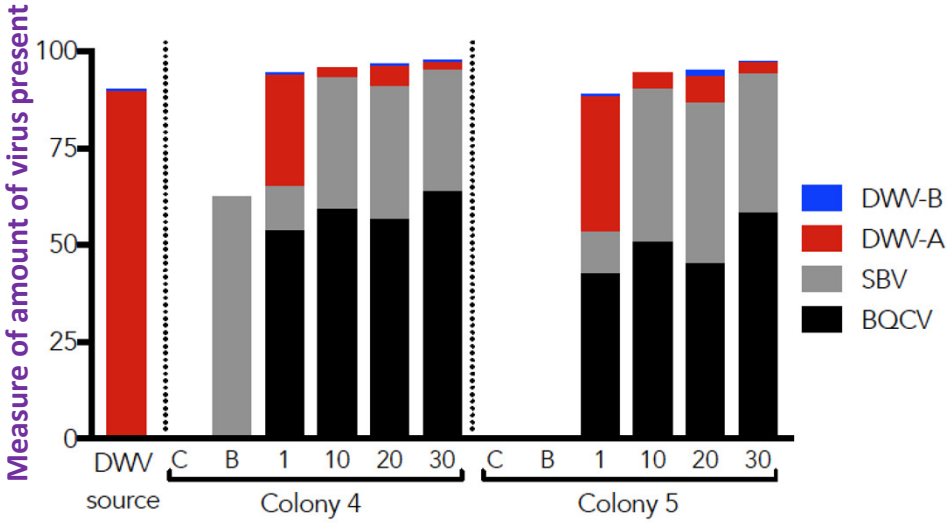
Serial transmission experiment - DWV



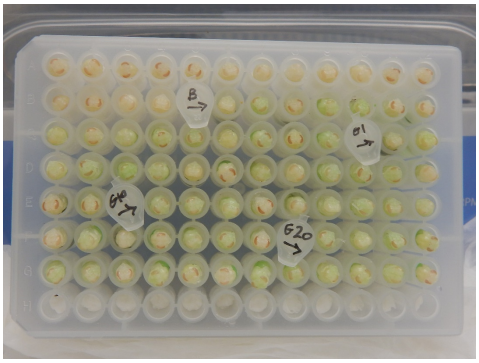
DWV rapidly decreases

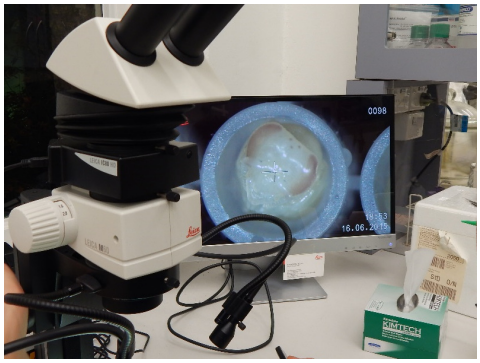


As the others increase



Survival assay – serial transmission experiment

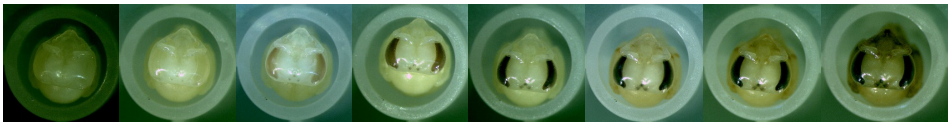




Developed by Thomas Gillard (then an Honours student)

Survival assay

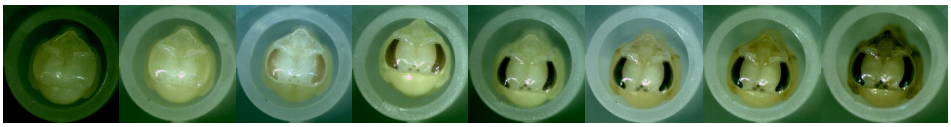
Control pupa



Day 0 Day 1 Day 2 Day 3 Day 4 Day 5 Day 6 Day 7

Survival assay

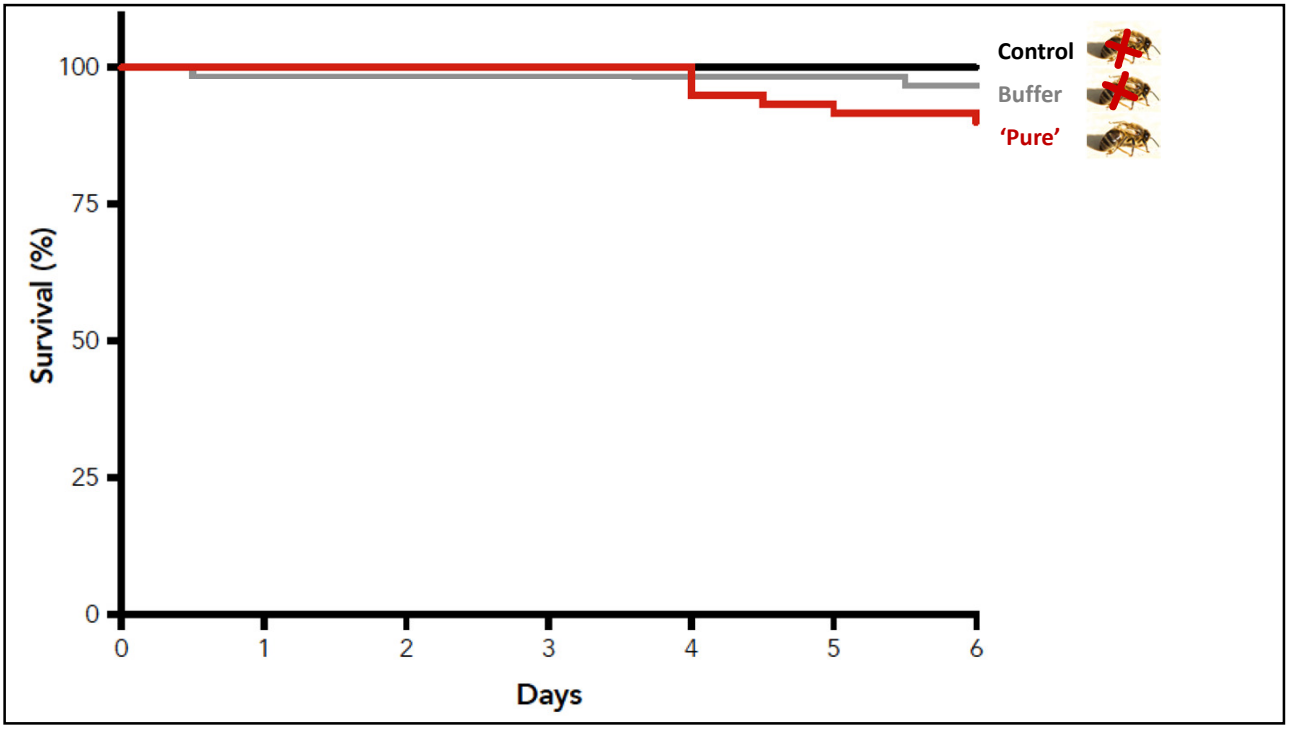
Control pupa

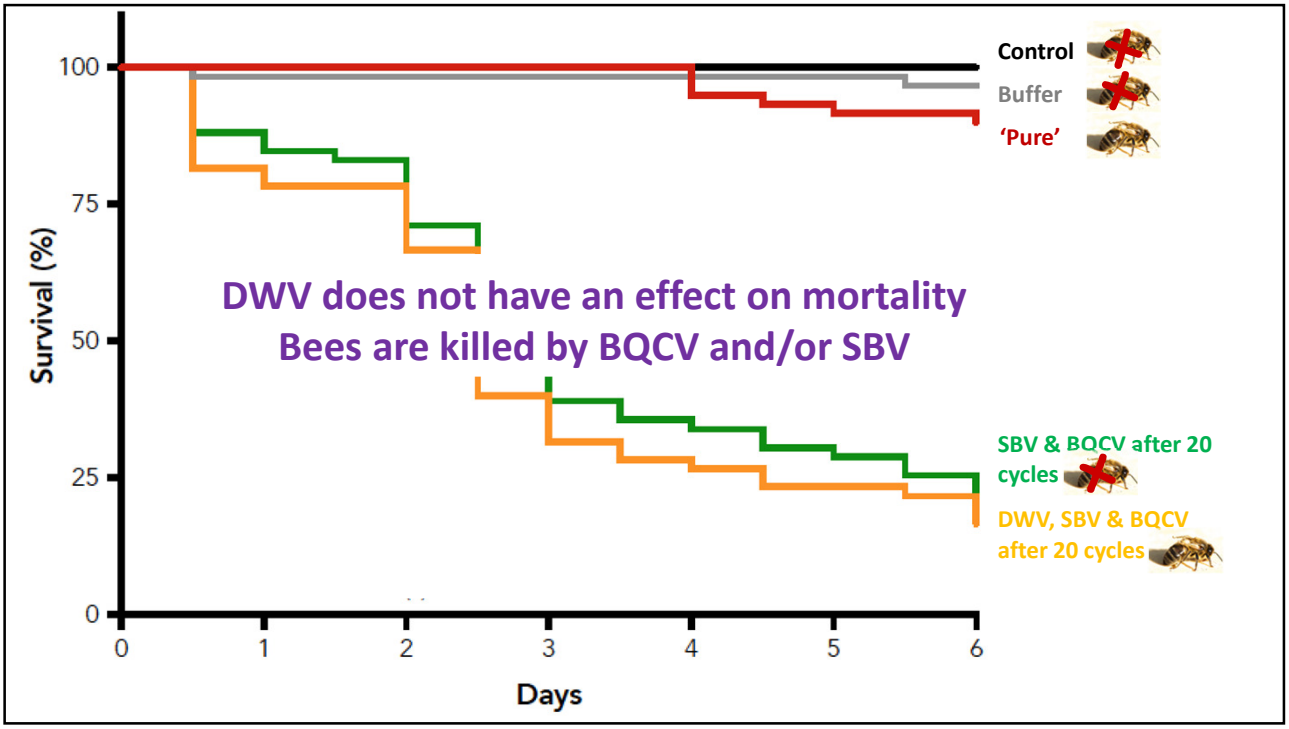


Day 0 Day 1 Day 2 Day 3 Day 4 Day 5 Day 6 Day 7

Haemolymph injected pupa

Day 0 Day 1 Day 2 Day 3 Day 4 Day 5 Day 6 Day 7





But how do you explain the association between DWV and *Varroa* everyone is talking about?

- Well, perhaps everyone else is wrong!
- The beauty of doing experiments……

DWV may well be an innocent bystander

- With the arrival of *Varroa* virulent viral strains emerge

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- When they kill the brood before it emerges, the mites will be killed too

DWV may well be an innocent bystander

- With the arrival of *Varroa* virulent viral strains emerge
- When they kill the brood before it emerges, the mites will be killed too
- This stops the spread of the viruses

DWV: the last man standing

- Once the nasties are gone, DWV can pop up

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To be continued….Emily will talk more about our work at 4:30pm today


Thank you