Darwin in de imkerij: natuurlijke selectie zorgt voor resistentie tegen *Varroa destructor*

Tjeerd Blacquière

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Symposium Bijengezondheid 25 maart 2017

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WILEY Evolutionary Applications

NEUMANN AND BLACQUIÈRE

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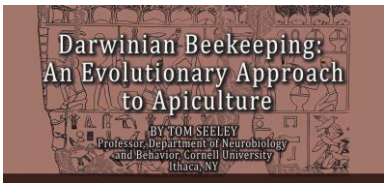
PERSPECTIVE

WILEY Evolutionary Applications

The Darwin cure for apiculture? Natural selection and managed honeybee health



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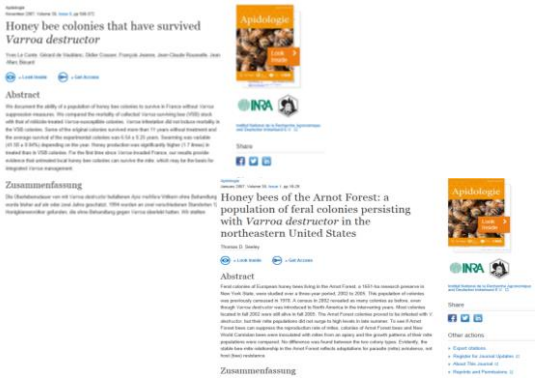

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DOI: 10.1051/apido:2006031

Original article

Survival of mite infested (*Varroa destructor*) honey bee (*Apis mellifera*) colonies in a Nordic climate*

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Received 7 November 2005 – Accepted 23 December 2005

Abstract – An isolated honey bee population (N = 150) was established on the southern tip of Gotland,

150 volken, + varroa, geen inmenging imker; sinds 2000

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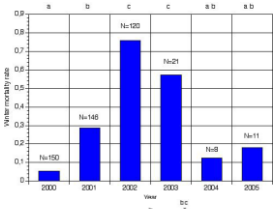
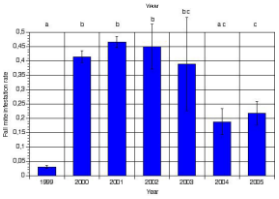
- Fries: Gotland
  - 150 volken uit Zweden
  - Wintersterfte volken ⟶
  - % varroa besmetting ⟶





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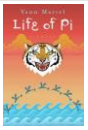

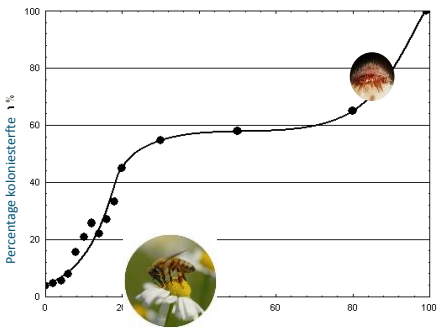

- Genersch et al., 2010
- Duitse monitoring 2004-08

Mijten/100 bijen in oktober

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Natuurlijke selectie

Uitgangspunten:

Varroa niet bestrijden

Vitale volken
- goede groei
- overleving
- reproductie (darrenraat!)
- bevruchting (eiland)
- geen spill-over mijten

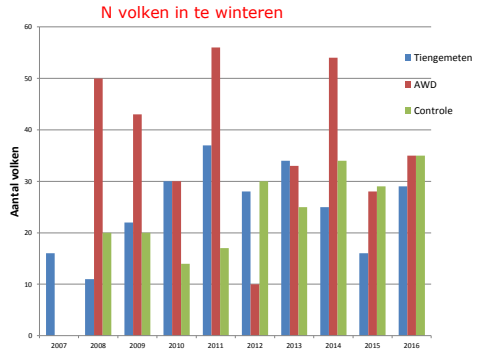
Controle:
- identiek (andere plek)
- 2X per jaar varroa bestrijding

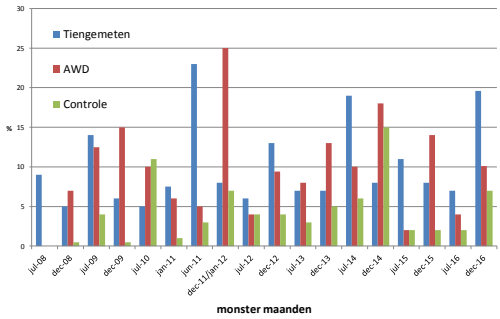
selectie

- einde zomer:
  - grootte (overwinterbaar)
    - NIET: (% mijt besmetting)
- voorjaar:
  - overleven
  - groei van de volken
  - productie van darrenbroed
- half mei: ~ 20 ramen bijen
  - verwijderen koningin
- na twee week: splitsen
  - 2-3 ramen broed + bijen + darren + onbevruchte koningin (+ mijten) ⟶ BABIES
- bevruchten 'eiland'.
- controles: Oxaalzuur in juli en dec

Tiengemeten groep

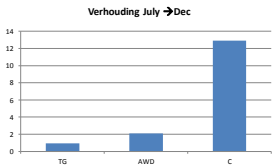
2007 vv.

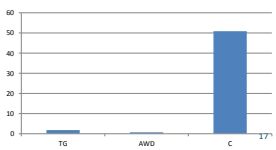




Verandering van de besmetting met mijten tussen juli en december (boven) en tussen december en juli volgend jaar (onder), van 2009-2015

- Besmetting:
  - verandert maar weinig in selecties
    - op en neer
  - verandert sterk in controle
    - altijd toename





Vanwaar geen toename van de besmetting?

- Mijt reproductie
  - vruchtbaarheid/on-fecundity (N dochters)
    - werkster broed
    - darren broed
- Grooming (auto- + allo-grooming)
- Hygiënisch gedrag
  - 'Hyg'
  - VSH
- (Volks- en seizoens-dynamiek)

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Review article

Natural *Varroa* mite-surviving *Apis mellifera* honeybee populations

Barbara Locke

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Received 18 April 2015 – Revised 28 September 2015 – Accepted 6 November 2015

	Brazil	South Africa	Fernando de Noronha	Primorsky, Russia	Gotland, Sweden	Avignon, France	Arnot Forest, NY, USA
Hygienic behaviour	☑	☑	☒	☑	☒	☐	☐
Grooming behaviour	☑	☑	☒	☑	☒	☐	☐
Small colony size	☑	☑	☒	☒	☑	☐	☑
Reduced development time	☑	☑	☐	☐	☒	☐	☐
Reduced mite reproduction	☒	☒	☒	☑	☑	☑	☐

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Mijt reproductie: onvruchtbaarheid

Fractie **niet reproducerende** mijten in werkster en darrenbroed (neutrale mijten, neutraal gastvolk) NB! nog maar weinig volken getest!

	control	AWD	TG
Werkster broed			
2011 (Michiel)	0.03 (N=231)	0.06 (N=180)	0.09 (N=409)
2014 (Tj + C)	0.09 (N=109)	0.15 (N=155)	0.63 (N=124)
Darren broed **2014** (Tj + C)	0.12 (N=496)	0.14 (N=472)	0.21 (N=891)

Fractie **niet reproducerende** mijten in werkster en darrenbroed (neutrale mijten, getest in de volken van de selecties). Effect kan dus deels door VSH komen.

	control	AWD	TG
werkster broed 2012 (Thijs)	0.12 (N=406)	0.16 (N=303)	0.12 (N=417)
Darren broed 2013 (Anne)	0.16 (N=75)	0.04(N=100)	0.12(N=100)
Darren broed 2015 (Katousha)	0.0 (n=11)	0.10 (N=91)	0.10 N=91)

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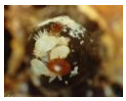
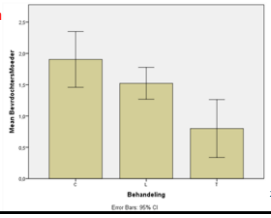
Mijt reproductie: aantal dochters

	control	AWD	TG	P
Werksterbroed 2011	2.49[a]	1.92[b]	2.02[b]	<0.001
Werksterbroed 2012	1.22[b] (292)	1.10[b] (222)	0.97[a] (290)	<0.05
	neutrale mijten, eigen volken (effect deels door VSH)			

N dochters / moeder mijt in werksterbroed. (N cellen met mijten: 196, neutrale mijten, neutraal gastvolk, 2014 Tj + Ch)





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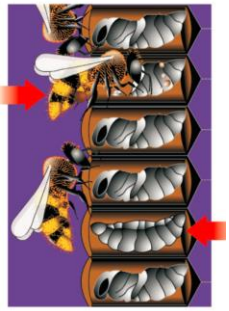
Hygiënisch gedrag

- = herkennen en verwijderen
  - betere neus
  - is te selecteren
  - werkt tegen AVB, bleek ook tegen kalkbroed en varroa
  - de uitruimers zijn 15-18 dagen oud
  - 'Gewoon' Hyg.
  - VSH



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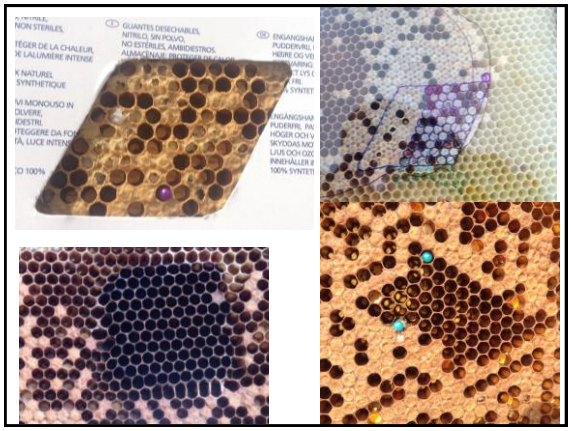


Results Pin-test (Arnout)

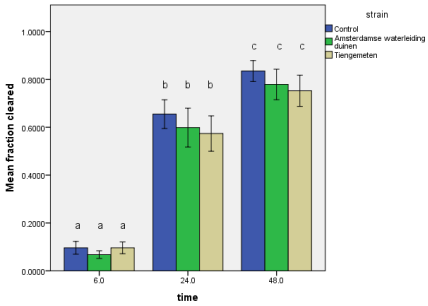


Figure1. Mean (+/- 1 SE) fraction cleared cells, 6, 24 and 48 hours after Pin-test by 6 colonies of each strain.

Results Frozen brood test

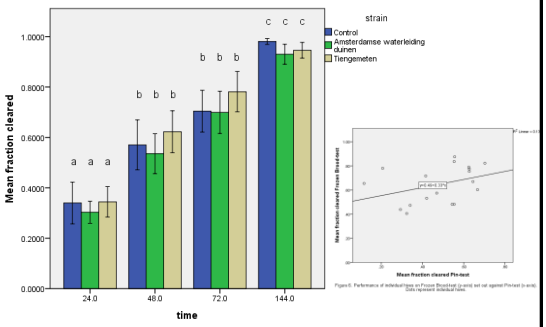
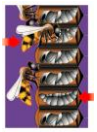
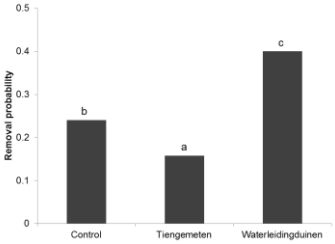


Figure2. Mean (+/- 1 SE) fraction cleared cells, 24, 48, 72 and 144 hours after Frozen Brood-test by 6 colonies of each strain.

VSH

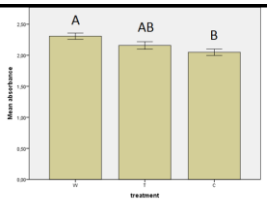
Delphine Panziera
- individuele introductie
- neutraal broed
- neutrale mijten
- data van ~ 250 geïnfecteerde cellen per groep

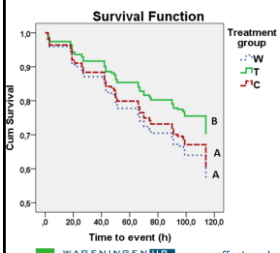


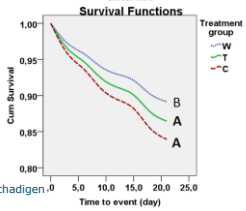


Grooming

Astrid Kruitwagen
- individuele bijen: zetmeel
- 80 bijen in kooitjes + 20 mijten (neutraal)
- volken + foretische mijten







geen effect op beschadigen mijten

Samenvattend

- Conclusies
  - Selectie op:
  - Overleving:
    - Vitaliteit + groeikracht
    - reproductief vermogen

Bijen
- Hygiënisch: NEE
- VSH: JA/NEE
- Grooming: NEE

Poppen
- Mijt onvruchtbaarheid: JA (werkster, dar)
- Mijt nakomelingen: JA (werkster)

- Selecties verschillen!!!

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Tabel (uit Locke, 2016), aangevuld met gegevens van de bijen@wur en VBBN Laren selecties

Trait	Brasil	South Africa	Fernan-do de Noronha	Primorski	Gotland	Avignon	Arnot Forest	AWD	TG	Laren
Hygienic behaviour (VSH)	+	+	x	+	x			+	x	
Grooming	+	+	x	+	x			x	x	
Small colonies	+	+	x	x	+	(+)	+	? ?	??	??
short capped brood time	+	+			x					
reduced mite repro (VSH?)	x	x	x	+	+	+		+	++	

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Met onderscheid Hyg en VSH

Eigenschap	Brazilië	Zuid Afrika	Fernan-do de Noronha	Primorski	Gotland	Avignon	Arnot Forest	AWD	TG	Laren
Hygiënisch gedrag (VSH)	+	+	x	+	x			x	x	Hyg
VSH								+	x	VSH
Grooming	+	+	x	+	x			x	x	
Kleine volken	+	+	x	x	+	(+)	+	? ?	??	??
korte tijd gesloten broed	+	+			x					
minder mijt reproductie (VSH?)	x	x	x	+	+	+		+	++	

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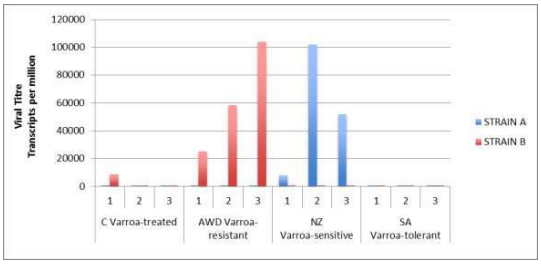
DWV/VDV-1 complex



Data van Remnant, Beekman et al., Univ Sydney

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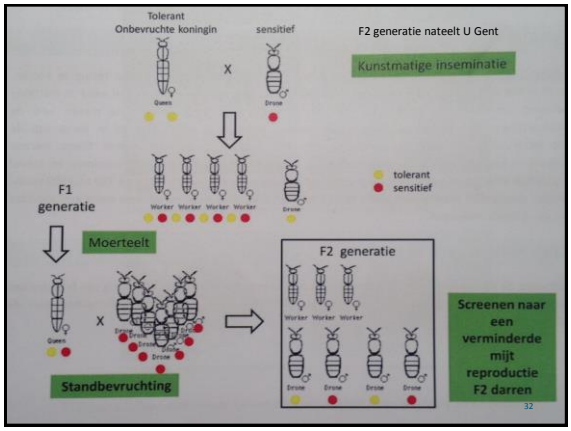

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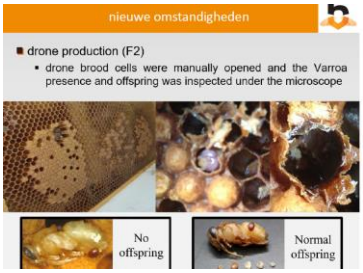
Onderzoek Gent

Verwacht:
stel F_0 = 100% resistent
→ F_2 darren: 50%

stel F_0 = 50% resistent
→ F_2 darren = 12.5%

Gevonden: geen repro op Darren:
onze selectie: **51%**
controle: 19%
andere: 15-37%



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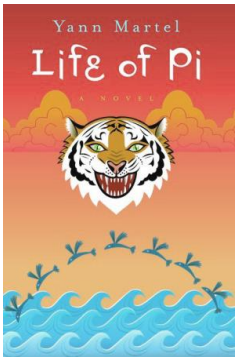

Plannen vervolg en doorlopend onderzoek

- Lord of the Rings
  https://www.researchgate.net/project/European-honey-bees-surviving-Varroa-destructor-by-means-of-natural-selection?
  - Internationale vergelijking en transplantatie
- Nationale vergelijking (Coby)
  - initiativen in NL + onze selecties
    - gebruikswaarde
- Interactie Resistentie bijen met Virussen (NWO)
  - Virologie + b@w, Delphine Panziera

  ????? NWO
- DEMO principe natuurlijke selectie
  - b@w, Bayer Bee Care, Inbuzz
  - start 2017 ⟶ 2021
  - NL en D (+…?)
  - Meedoen? Melden!

tjeerd.blacquiere@wur.nl

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Thanks for your attention

& thanks to all who helped: Chula, Thijs, Janneke, Jolanda, Michiel, Delphine, Astrid, Anne, Katousha, Bram, Frank, Janse, Arnout Willem, Johan, Pam

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