Sirex woodwasp biocontrol: success, but not as we know it

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University of the Sunshine Coast | Forest Research Institute

FABI

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NSW GOVERNMENT Primary Industries

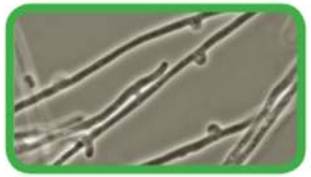
Forest & Wood Products Australia

National Sirex Coordination Committee

Sirex woodwasp

(& its fungal symbiont)

- native to Eurasia
- most important pest of pines in southern hemisphere
- complex invasion history
  - NZ, Australia, South America, North America, South Africa, China, EU



Slippers et al. 2015.

Sirex

NZ

Tas

Vic

Uruguay

NSW, SA

Argentina

Brazil

South Africa

Chile

NY

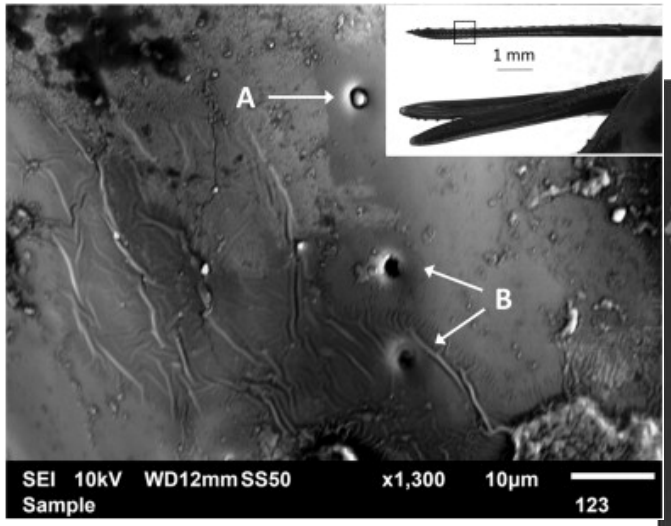
Canada

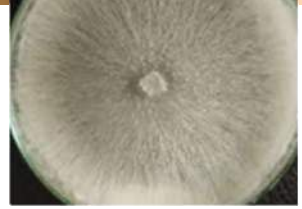
Qld

China

1900---1950 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 now

Sirex woodwasp



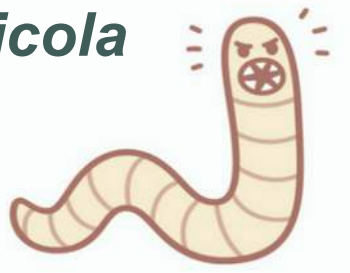


1. Venom
2. Spores
3. Eggs

Sirex woodwasp - biocontrol

Parasitoid wasps
- ***Ibalia***
- *Megarhyssa*
- *Rhyssa*
- *Schlettererius*

Mycetophagous-parasitic nematode
Deladenus siricidicola



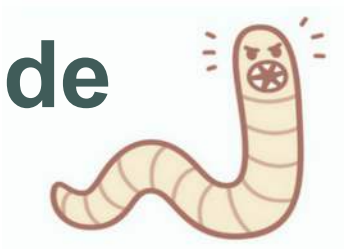
Deladenus siricidicola

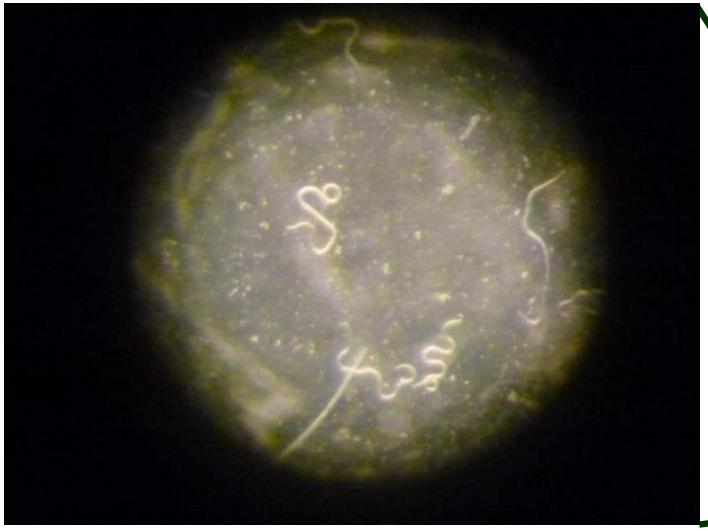
"the nematode"

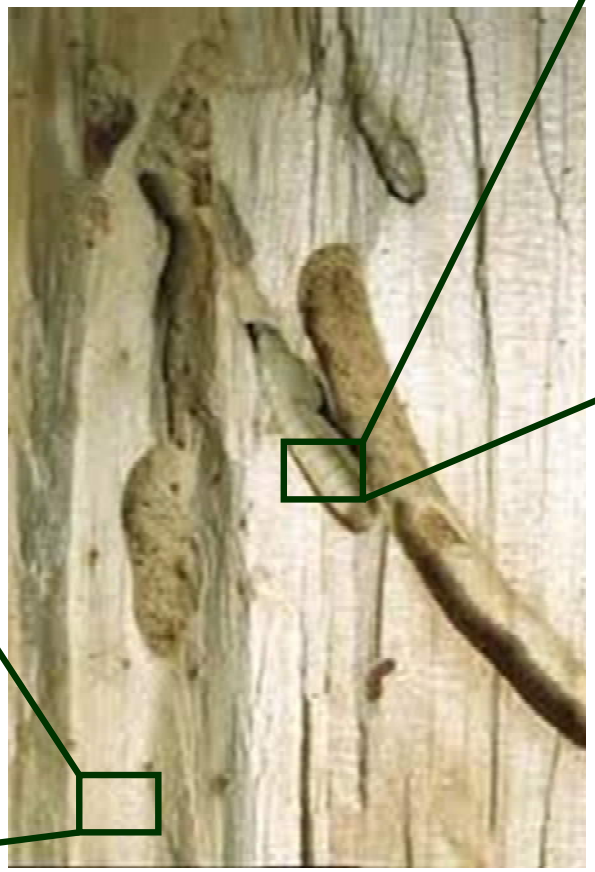
- “mainstay of Sirex management”
  - parasitism rates up to 90%
- developed & commercialised in Australia
  - hundreds of strains screened
    - one selected (Sopron → Kamona)
- augmentatively released South America, South Africa, Australia

the nematode

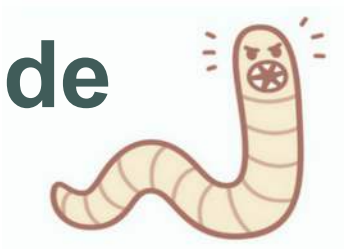
the nematode

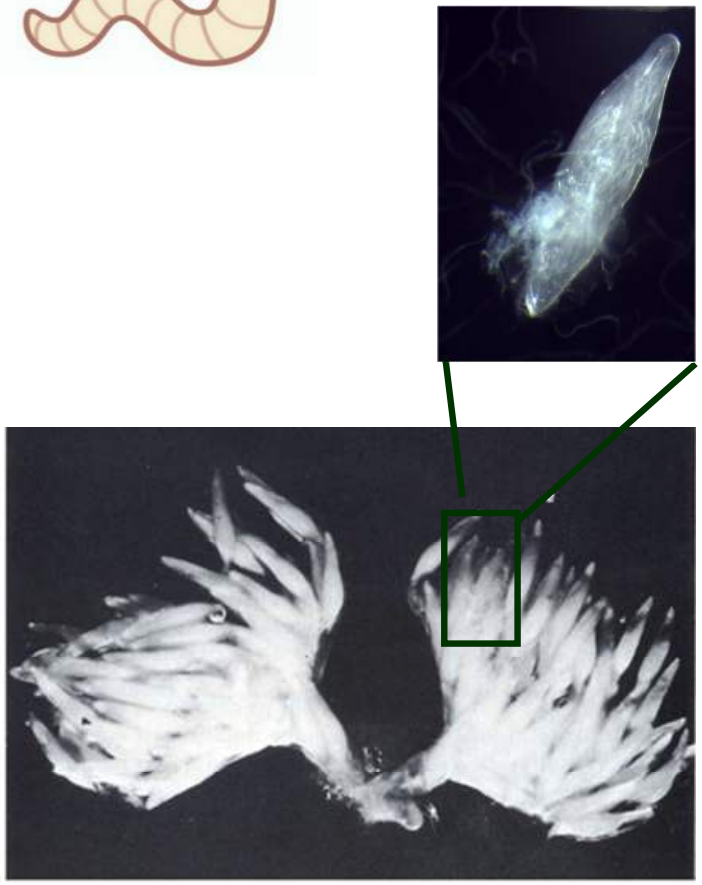


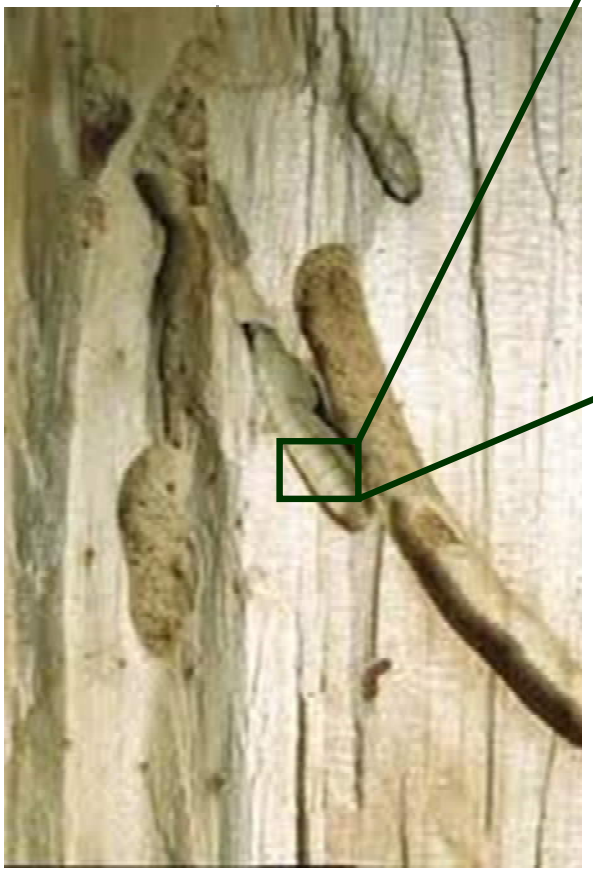




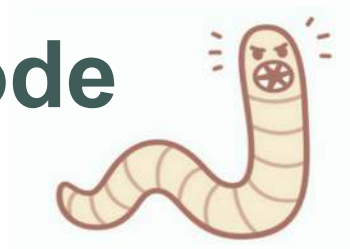
the nematode



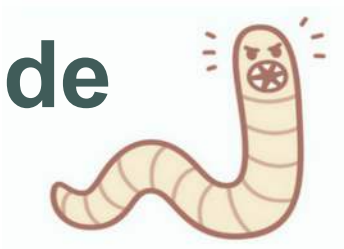


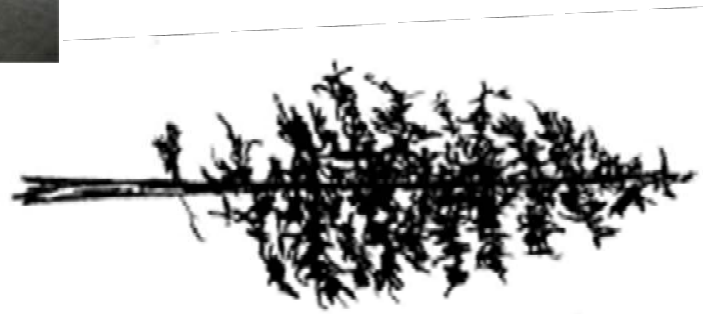


the nematode



the nematode

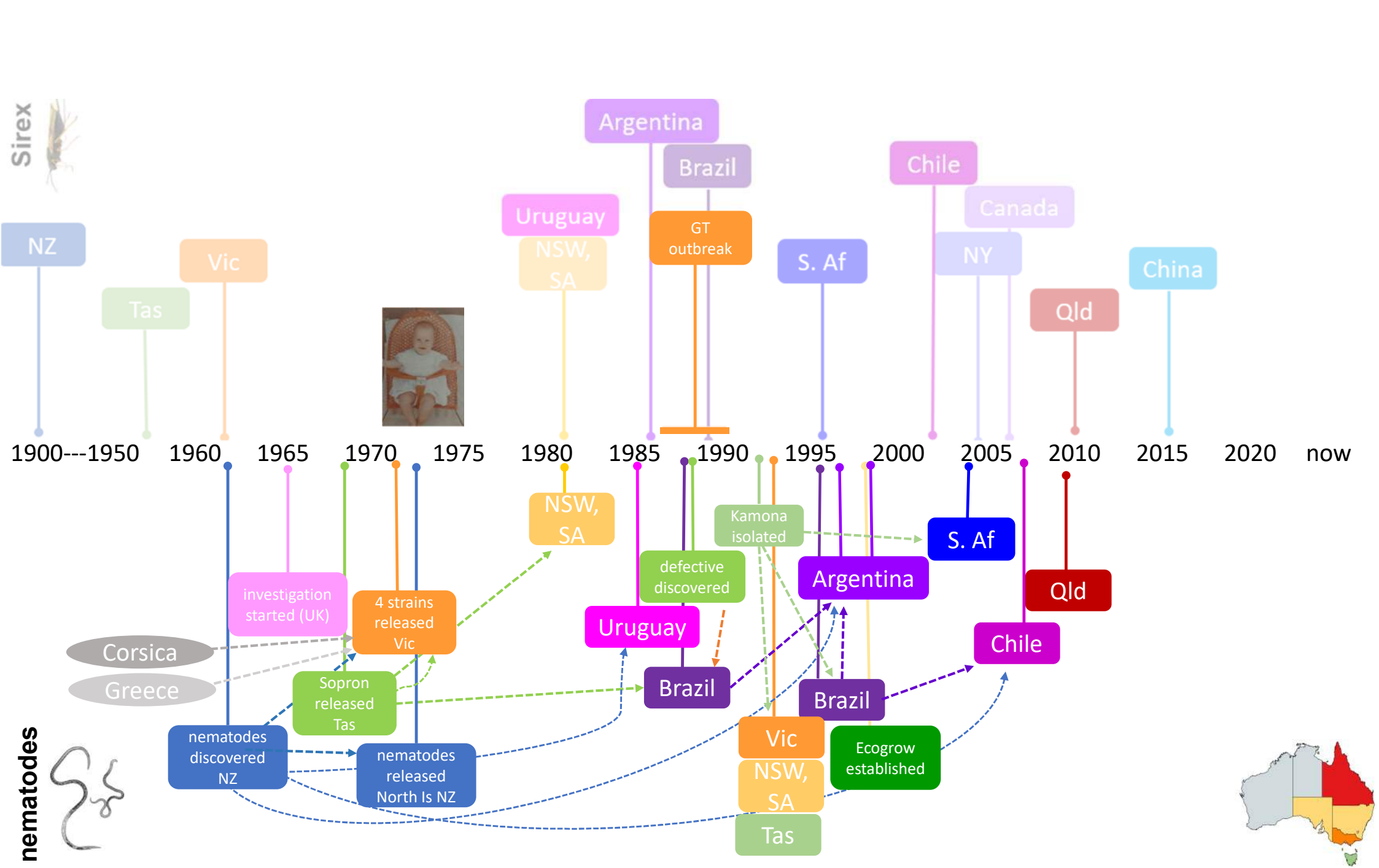




the defective nematode

- GT outbreak late 1980s
  - continuous mass-rearing
    → loss of virulence

- re-collected from Tasmania
  - **Kamona strain**
  - commercialised ~2000
  - South Africa, South America


Sirex
Argentina
Brazil
Uruguay
GT outbreak
Chile
Canada
NZ
Vic
NSW, SA
S. Af
NY
China
Tas
Qld
1900---1950
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
now
NSW, SA
Kamona isolated
S. Af
defective discovered
Argentina
Qld
investigation started (UK)
4 strains released Vic
Uruguay
Chile
Corsica
Greece
Sopron released Tas
Brazil
Brazil
Vic
Ecogrow established
nematodes discovered NZ
nematodes released North Is NZ
NSW, SA
Tas
nematodes

a few issues...

Journal of Pest Science (2019) 92:131–142
https://doi.org/10.1007/s10340-018-1060-3

REVIEW

Management of *Sirex noctilio* populations in exotic pine plantations: critical issues explaining invasion success and damage levels in South America

Juan C. Corley[1,2] · María Victoria Lantschner[1] · Andrés S. Martínez[1] · Deborah Fischbein[1] · José M. Villacide[1]

BioControl (2018) 63:739–749
https://doi.org/10.1007/s10526-018-9897-1

The fungal matrices of *Ophiostoma ips* hinder movement of the biocontrol nematode agent, *Deladenus siricidicola*, disrupting management of the woodwasp, *Sirex noctilio*

F. Yousuf · A. J. Carnegie · R. Bashford · H. I. Nicol · G. M. Gurr

Agricultural and Forest Entomology (2007), **9**, 159–171 DOI:10.1111/j.1461-9563.2007.00340.x

REVIEW ARTICLE

A comparison of control results for the alien invasive woodwasp, *Sirex noctilio*, in the southern hemisphere

Brett P. Hurley, Bernard Slippers and Michael J. Wingfield
Department of Genetics, Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, Pretoria 0002, South Africa

ELSEVIER
Biological Control
Volume 45, Issue 3, June 2008, Pages 450-459

Factors influencing parasitism of *Sirex noctilio* (Hymenoptera: Siricidae) by the nematode *Deladenus siricidicola* (Nematoda: Neotylenchidae) in summer rainfall areas of South Africa

Brett P. Hurley [a], Bernard Slippers [a], Philip K. Croft [b], Hardus J. Hatting [a], Mike van der Linde [c], Andrew R. Morris [d], Colin Dyer [b], Michael J. Wingfield [a]

ELSEVIER
Biological Control
Volume 59, Issue 3, December 2011, Pages 348-353

Extreme homozygosity in Southern Hemisphere populations of *Deladenus siricidicola*, a biological control agent of *Sirex noctilio*

X. Osmond Mlonyeni [a], Brenda D. Wingfield [a], Michael J. Wingfield [a], Rodrigo Ahumada [b], Paula Klasmer [c], Isabel Leal [d], Peter de Groot [e], Bernard Slippers [a]

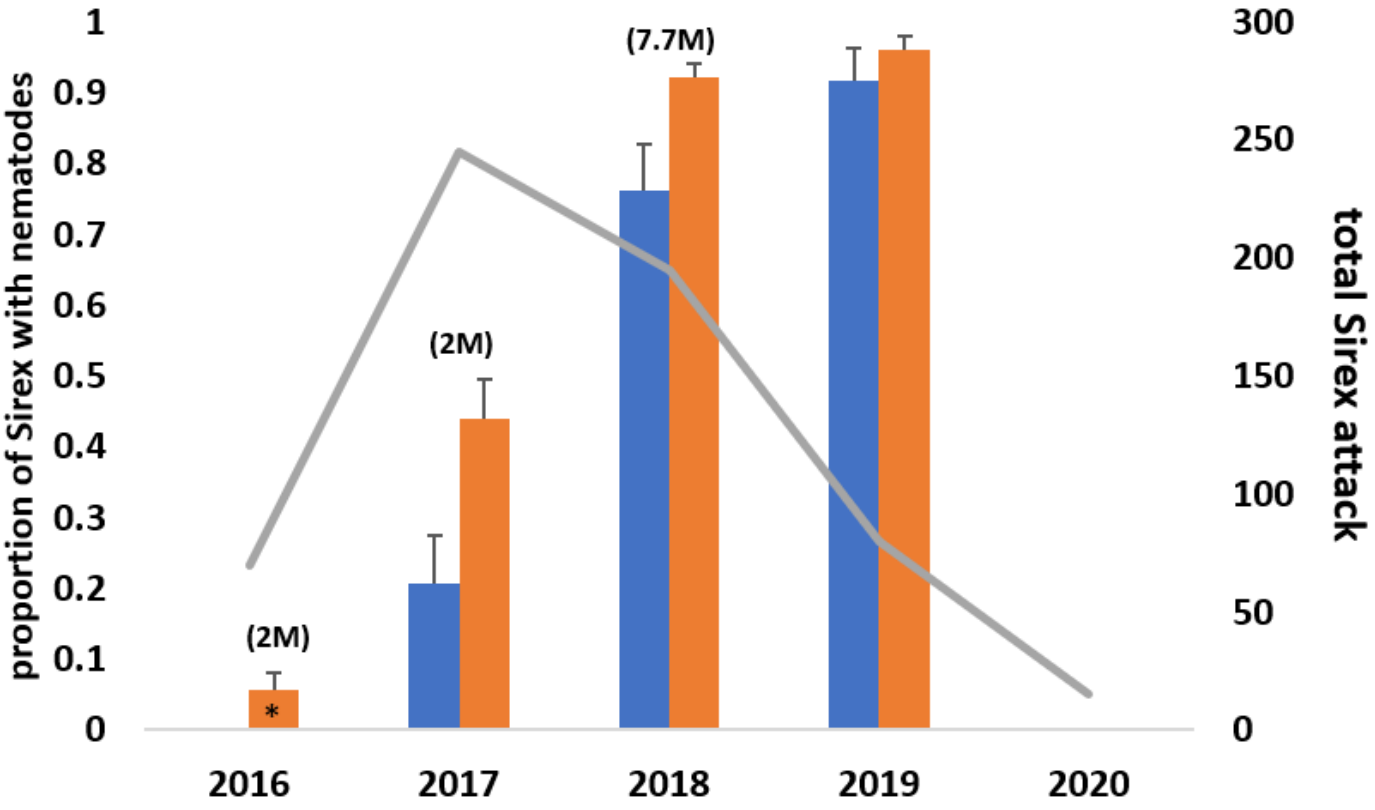
meanwhile in Australia...

- 2009 – Sirex gets to Qld
- 2011 – nematode releases begin
  (spoiler: they didn't establish)

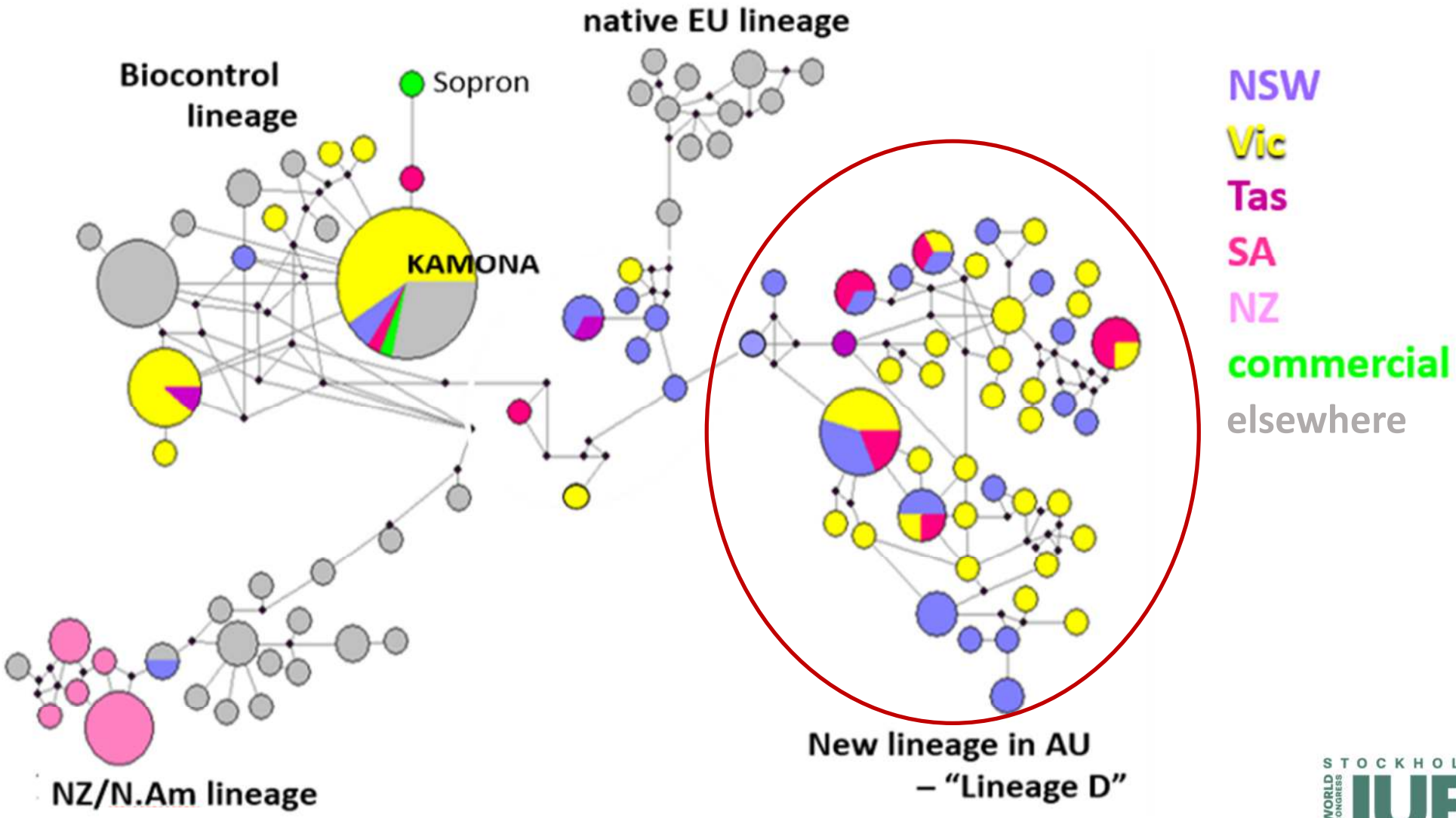
- 2017 – TTP audit
  - low numbers of parasitised females
    - review of TTP practices
      - Ips bark beetles
      - change herbicide, timing etc

- …but background parasitism levels good, Sirex levels low

an outbreak in NSW



everything is working
Yay!



Eshetu FB, Barnes I, Nahrung HF, Fitza KNE, Meurisse N, Slippers B (2023) Unexpected diversity in historical biological control programs: population genetics of *Deladenus siricidicola* in Australia and New Zealand. Biological Control 180: 105183

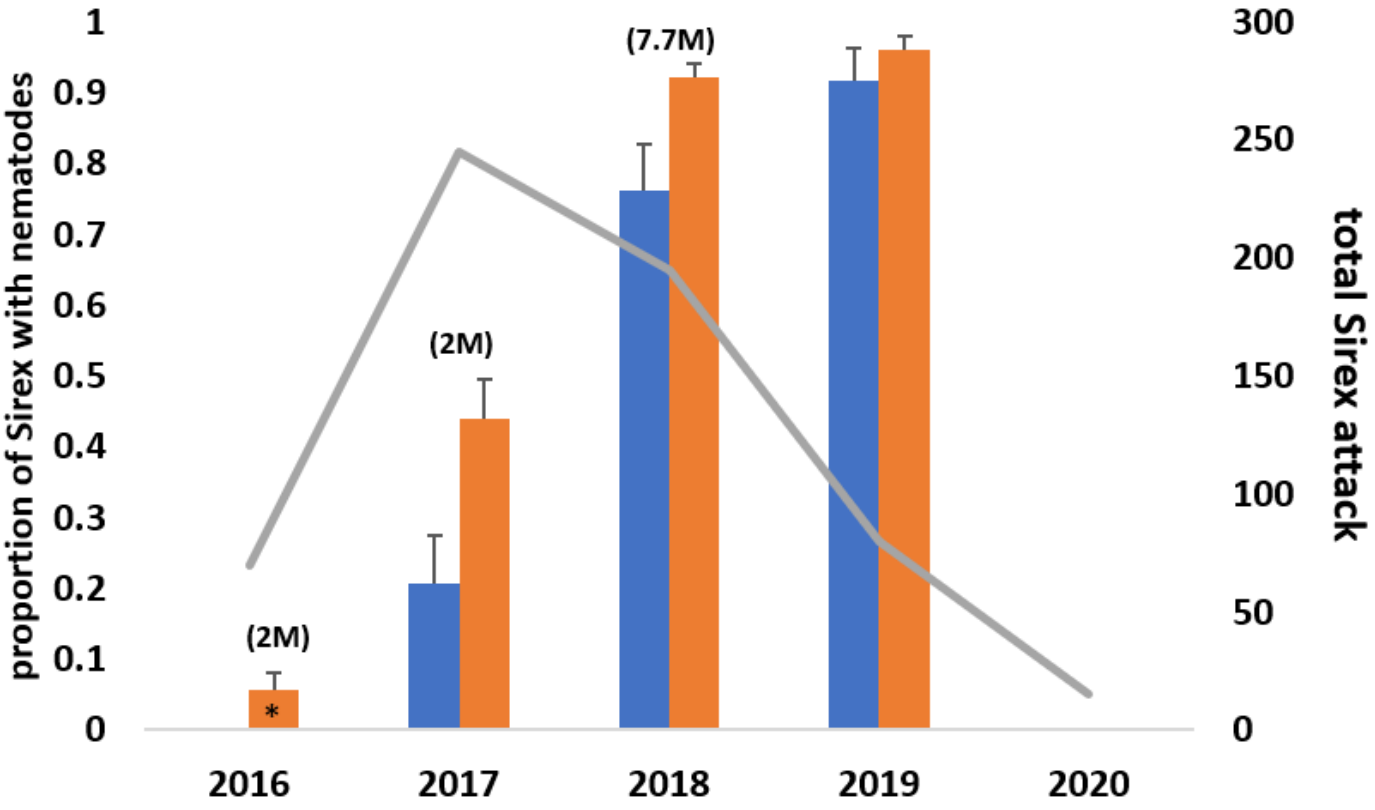

BOOM!

on further investigation

- 83% of nematodes in background populations were Lineage D

- 17% of nematodes from inoculated trees were Lineage D

and this?



100% of nematodes were Lineage D (!)

a good news story...(?)

DELIVERED WEEKLY TO 15 200

timber & FORESTRY enews

ISSUE 761 // June 29, 2023

ABC NEWS

Brisbane
Change location

ABC RURAL

New parasitic roundworm to boost biological battle against pine tree-killing Sirex wasp

ABC Rural / By Jennifer Nichols

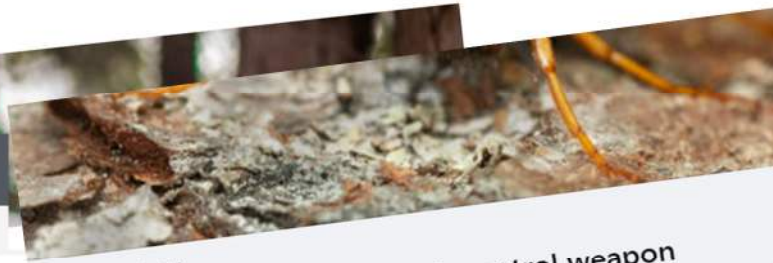
Posted Sat 24 Jun 2023 at 11:26am

New Sirex wasp control

COVER STORY P6

SUNSHINE COAST NEWS

'Hugely significant for science': how worm could protect pine trees from wasp pests



USC.EDU.AU

Attack worm may be new biocontrol weapon

A strain of roundworm discovered for the first time in Austra

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Global breakthrough to combat major threat to Aussie pine

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Lineage D

a "new" nematode

- Lineage D:
  - higher reproductive rate than Kamona
  - higher genetic diversity than Kamona
    - being released/considered for release
  - hybridisation rare in the field
  - origin unknown – one of the four initially released?
  - classical biocontrol agent

Don't assume!
- importance of molecular studies in pest management/biocontrol

acknowledgments

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Nicolas Meurisse
Stephen Elms

references

Slippers B, Hurley BP, Wingfield MJ (2015) Sirex woodwasp: a model for evolving management paradigms of invasive forest pests. Annual Review of Entomology. 60:601-19

Eshetu FB, Barnes I, Nahrung HF, Fitza KNE, Meurisse N, Slippers B (2023) Unexpected diversity in historical biological control programs: population genetics of *Deladenus siricidicola* in Australia and New Zealand. Biological Control 180: 105183

Nahrung HF (2017) *Sirex noctilio* (Hymenoptera: Siricidae): revisiting some past perceptions. Austral Entomology 56: 148-152

Wang T, Zhao M, Rotgans B, Ni G, Dean JFD, Nahrung HF, Cummins S (2016) Proteomic analysis of the venom and sac tissue of the woodwasp, *Sirex noctilio*, towards the understanding of biological impact on trees. Journal of Proteomics 146: 195-206

Hayes RA, Griffiths MW, Nahrung HF (2015) Electrophysiological activity of the *Sirex noctilio* ovipositor: you know the drill? Journal of Asia-Pacific Entomology 18: 165-168