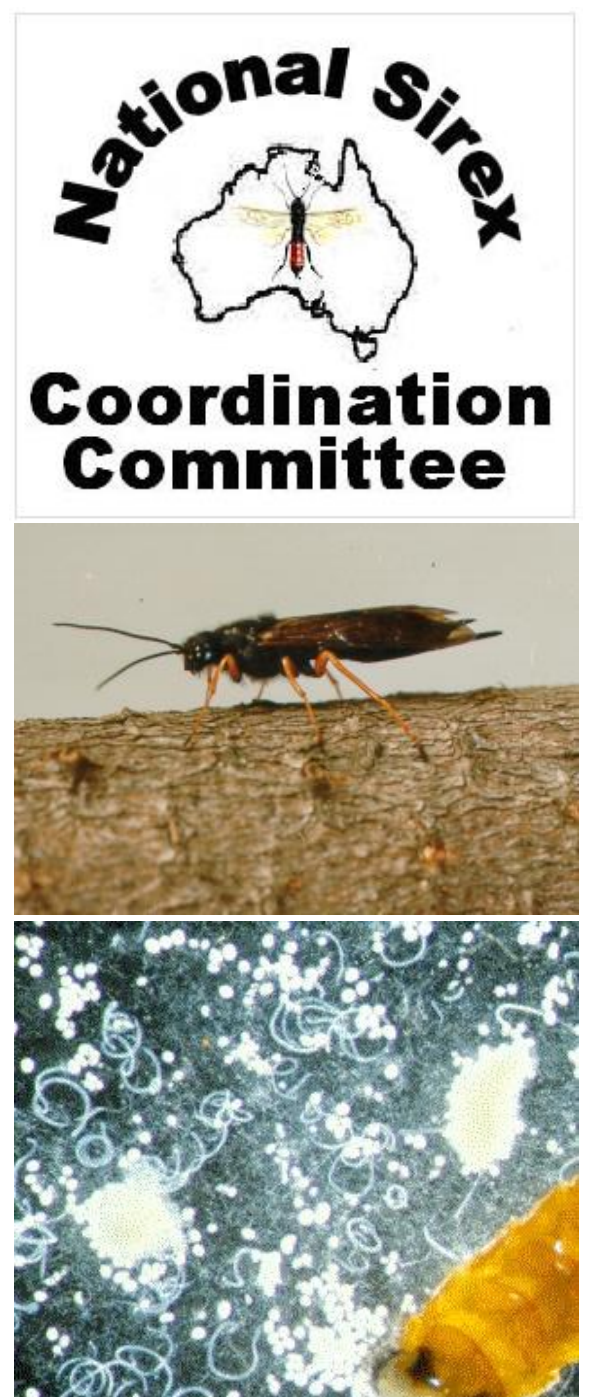




Is a rogue nematode controlling sirex wood wasp in Australia?

Angus Carnegie, NSW Department of Primary Industries
Helen Nahrung, University of the Sunshine Coast
Stephen Elms, HVP Plantations



Sirex: a primary pest in *Pinus* plantations

Pittwater, Tasmania, 1948–1962

- 1,100 ha, 30–80% trees killed
- \$5.7 million



Green Triangle, 1986–1989

- 56,500 ha, 5 million trees killed
- \$21.6 million



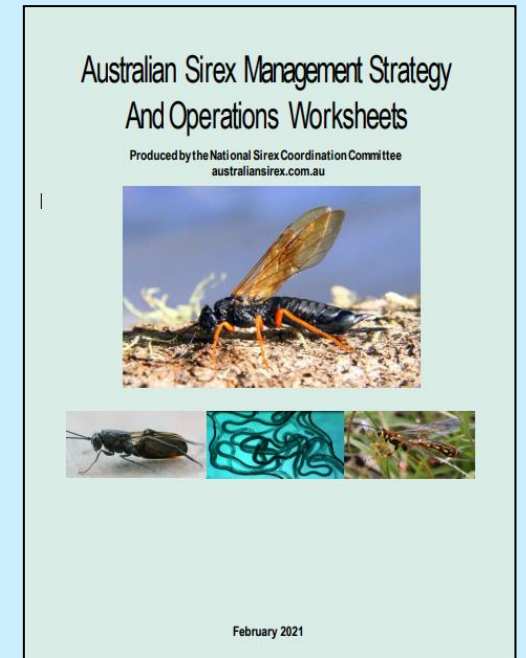
Biocontrol of sirex

- Australian Sirex Biological Control Unit: 1963, UK
 - Collect and identify parasitoids across Europe, North Africa, North America
 - Quarantine laboratory in Australia (Tasmania) to rear and release
- Parasitic wasps
 - *Ibalia leucospoides*, *Megarhyssa nortoni*, *Schlettererius cinctipes*, *Rhyssa* spp.
 - Mass-reared and released in 1970s and 1980s; now established
- Nematodes
 - Four strains of *Deladenus siricidicola* initially released in 1970
 - Up to 100% parasitism of emerging Sirex
 - ‘Sopron’ subsequently mass-reared and inoculated annually
 - Discovery of ‘Defective’ strain in 1990
 - >Replaced with ‘Kamona’ strain from 1991
 - >> Flood-out Defective strain with Kamona strain



Sirex Management Strategy

1. Stocking management: timely thinning to reduce tree stress
2. Surveillance: detect and monitor spread and outbreaks
3. Biological control:
 - Nematodes:
 - >Establish and inoculate trap tree plots annually across the estate
 - >Inoculate naturally struck trees during outbreaks
 - Annual monitoring of parasitism by parasitoids and nematodes from both inoculated and un-inoculated trees



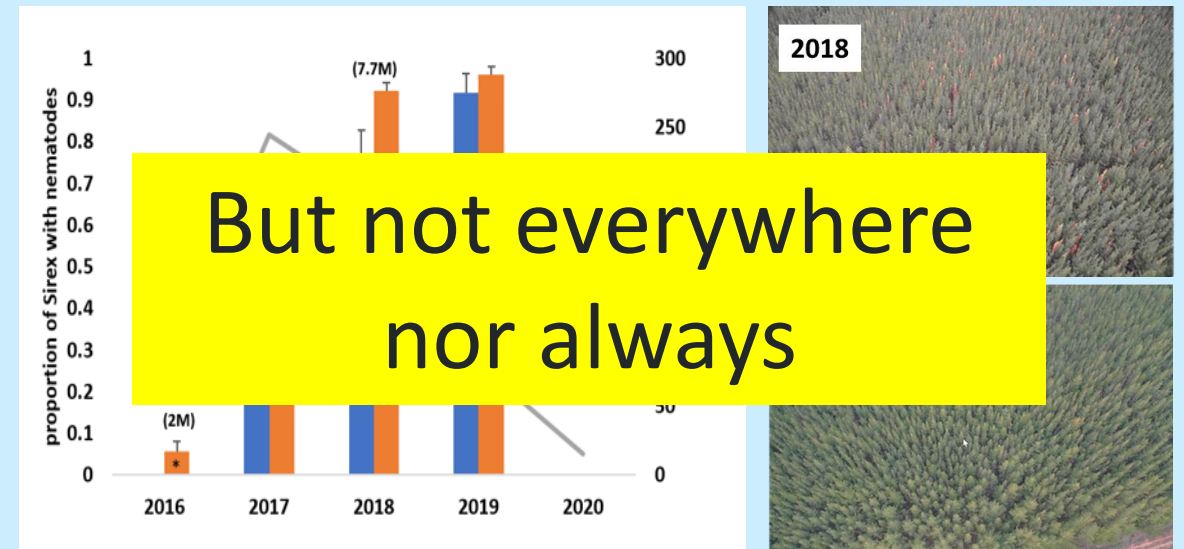
Effectiveness of biocontrol program

Evidence from inoculated trees:

- Inoculating with Kamona results in up to 100% parasitism of emerging wasps
- *But can be variable*

Field evidence from sirex outbreaks:

- Increased inoculation with Kamona results in increased parasitism of emerging wasps and subsequent crash of sirex outbreak



Sunny Corner outbreak

Variability in control: operational research to improve control

Low numbers of wasps emerging from trap tree plots in NSW in ~2000

- But still good background parasitism

Ips bark beetles attacking trap tree plots (2006) ... the cause of low numbers?

- Suboptimal establishment resulted in ips attack and bluestain that impacted sirex parasitism
- Optimise trap tree procedures to reduce ips attack

Sirex reaches Queensland (2009)

- Despite millions of Kamona inoculations, unable to establish Kamona in Qld

Trap tree plot audit showed wide variation in methodology (2017)

- Inconsistent results within and across growers
- Low numbers of parasitised females emerging (i.e. low “effectiveness” of TTP)

Issues with trap trees, but still good background levels ...?

A new strain of nematode discovered!!!

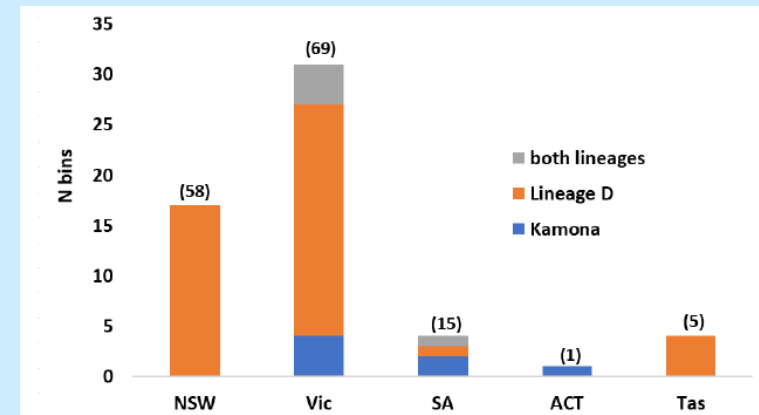
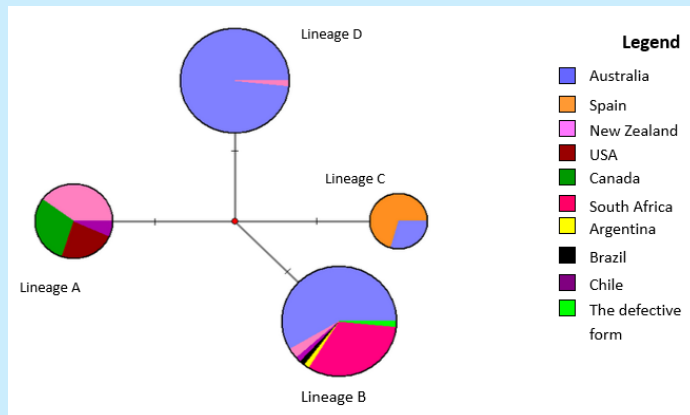


Investigation into the genetic diversity within *Sirex noctilio*, *Amylostereum aerolatum* and *Deladenus siricidicola* in Australia

- An aim of this study was to determine whether genetic diversity in these three taxa may be responsible for variability in effectiveness of sirex biocontrol and whether this diversity could be used to improve biocontrol

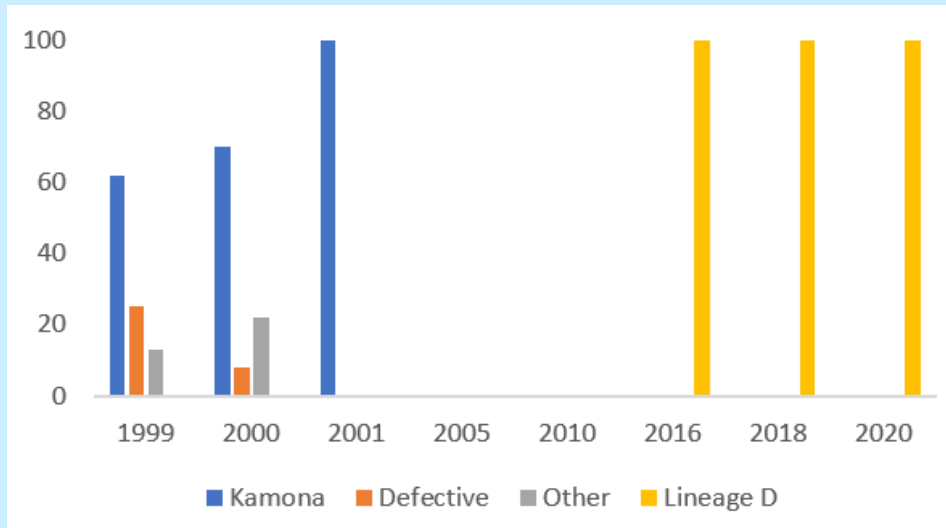
1. Inadvertently and surprisingly discovered a new strain of nematode: Lineage D

2. Lineage D widespread in Australia despite inoculations with billions of Kamona



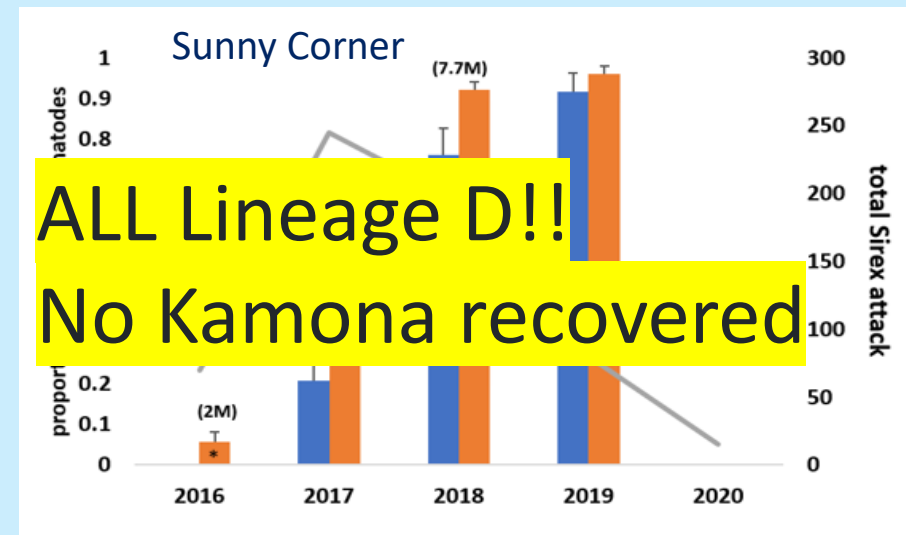
Revisit old truths...

Lineage D now dominant in areas once dominated by Kamona



Now only Lineage D

Lineage D controlled outbreak, not Kamona



Despite inoculating 16 million Kamona, a **background population of Lineage D built up to control sirex**

Implications of Lineage D discovery

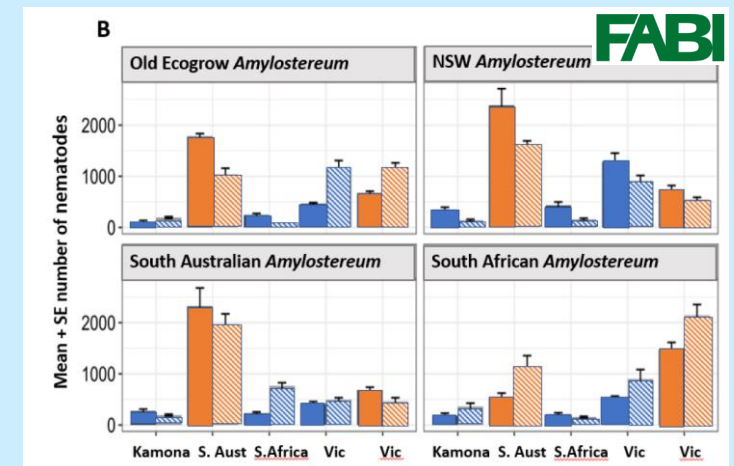
Where did it come from?

- Perhaps one of the original four strains released in Australia...?

Why is it now dominating despite such high numbers of Kamona being inoculated?

- Low effectiveness of trap tree plots since 2000 (i.e. low numbers of wasps emerging)
- Is Lineage D “fitter” than Kamona...?
- Does Lineage D have a competitive advantage to Kamona...?

Should we now change from Kamona to Lineage D?



What are we doing about it?



Primary focus of funds within the National Sirex Levy (\$0.11/ha)

NSCC funding initial project to test Lineage D

FWPA project proposal - full project (co-funded by NSCC)

International Workshop in Brazil (September 2023)

Continued collaboration with global partners

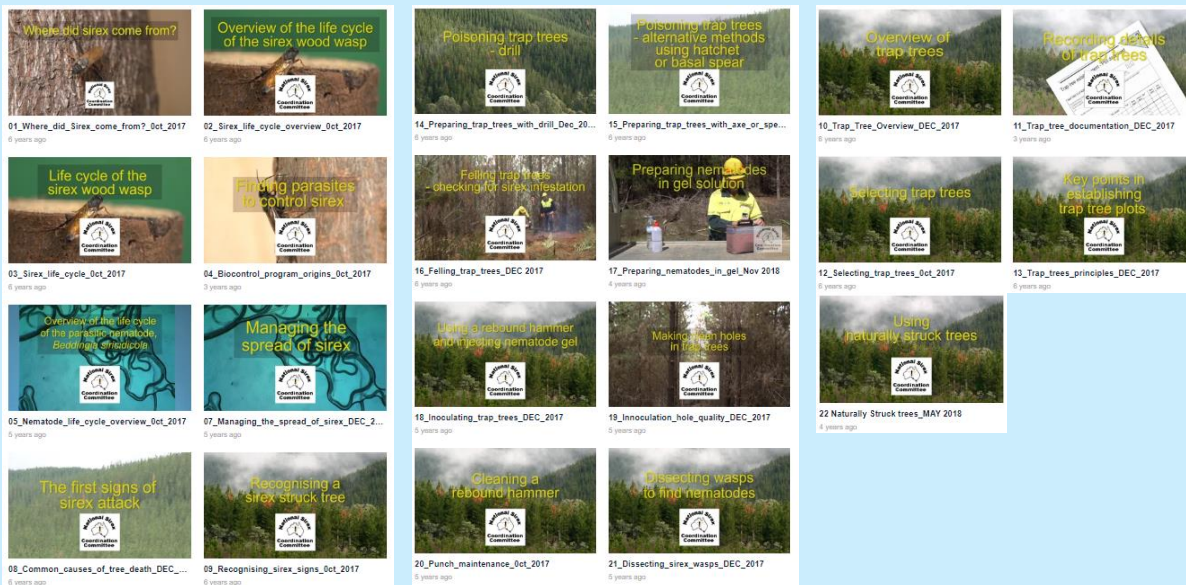
Annual meeting in November

Writing position paper for industry

National Sirex Coordination Committee

<http://australiansirex.com.au/>

- Operations worksheets, Field checklists, Publications, Training videos
- <https://vimeo.com/channels/1309879>

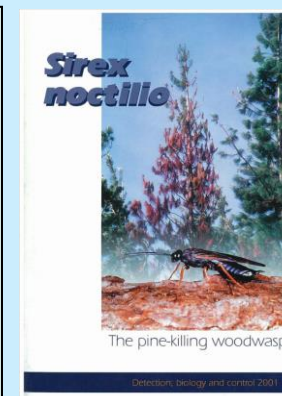
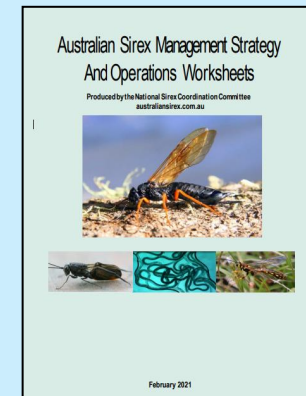


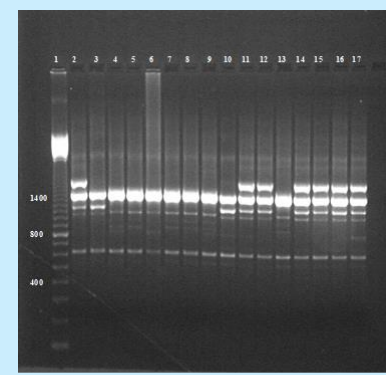
Biological control of sirex woodwasp in Australia

Managing a serious pest of pine plantations



Home Sirex Control Research Status Contact Us Links

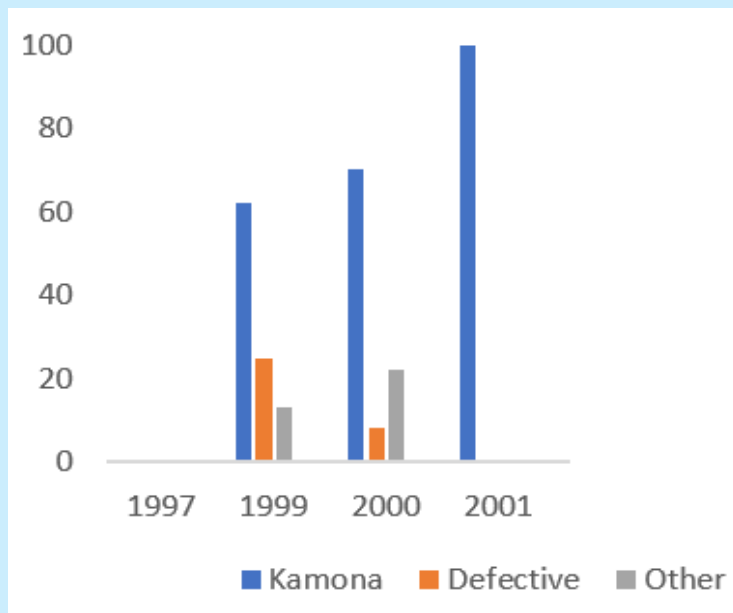




RAPD analysis

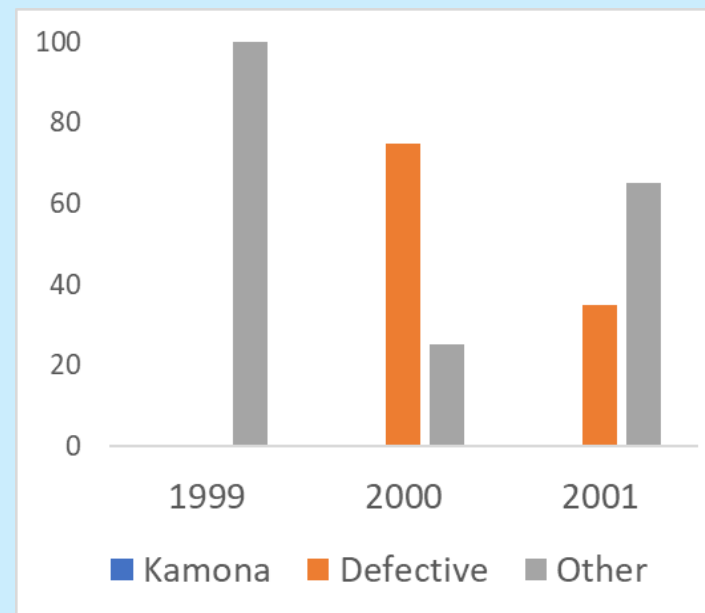
Flooding with Kamona strain

- In areas where sirenix is newly established and nematodes were new (Northern Tablelands), Kamona dominated.

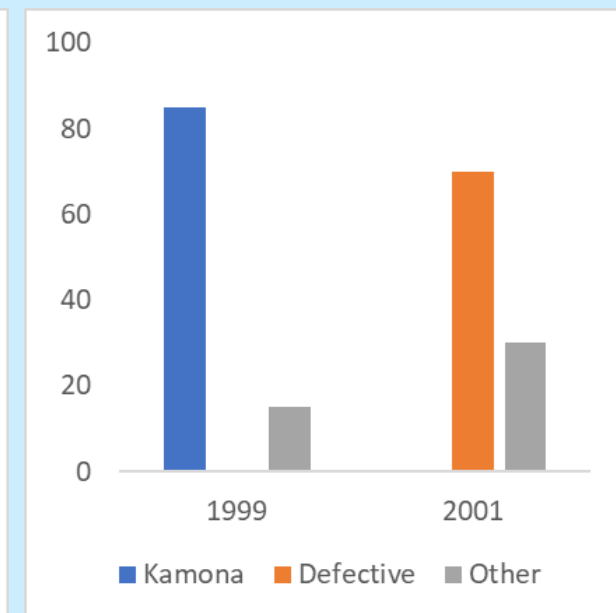


Walcha flooded with Kamona

- Where sirenix was long-established and Defective had been inoculated, mixed results



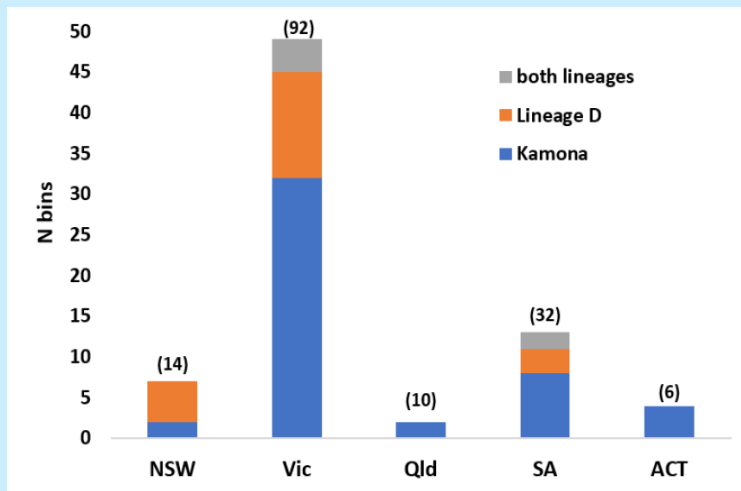
Victoria



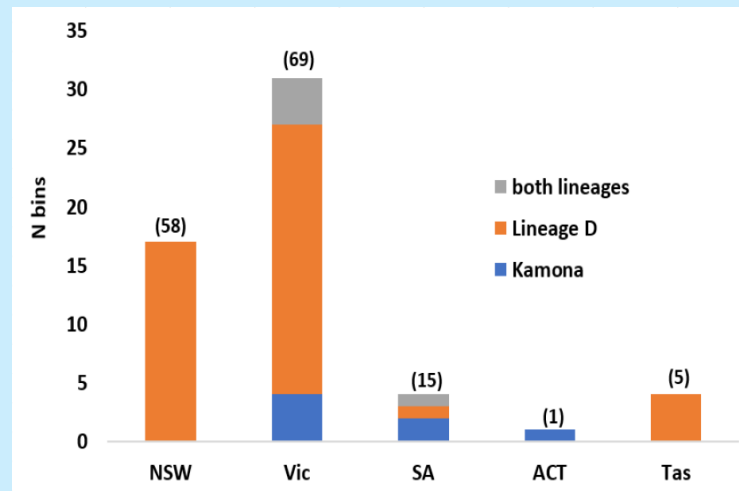
ACT

Inoculation works, but where do Kamona go?

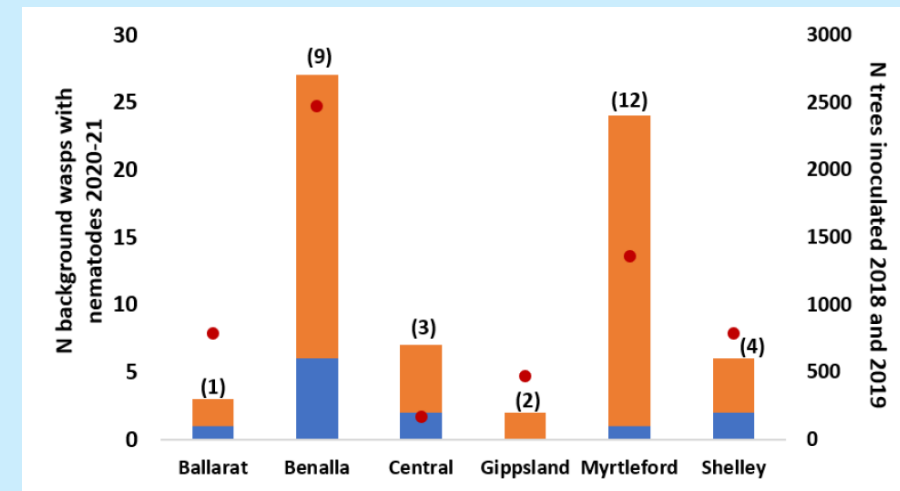
...?



Inoculated trees have good Kamona emerging...



But they are not establishing in background population...



Regardless of how many Kamona we inoculate.