Department of
Primary Industries and
Regional Development

GOVERNMENT OF
WESTERN AUSTRALIA

Protect
Grow
Innovate

Can deep tillage improve a soils biological diversity?

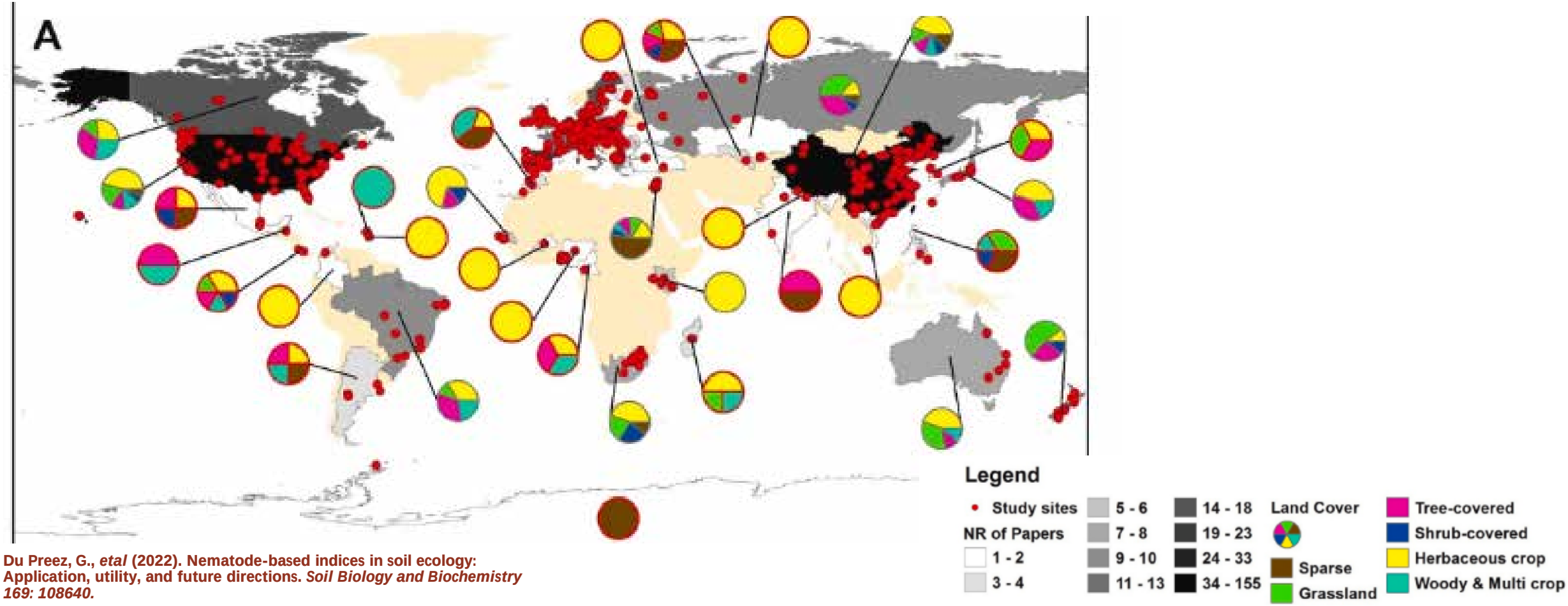
[illegible]

[illegible]

Nematodes as Bioindicators

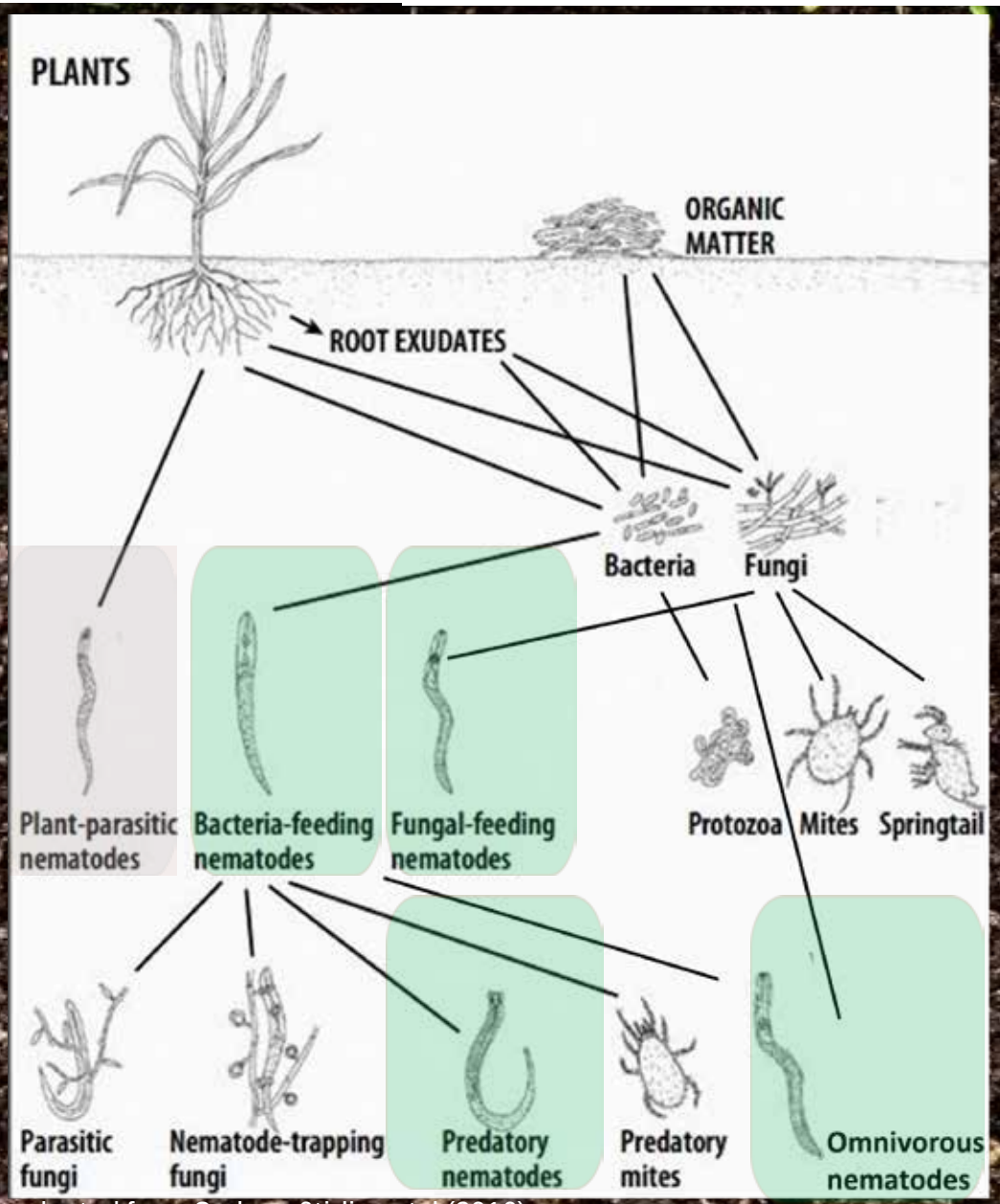
EVOLUTION OF NEMATODE-BASED INDICES

Using nematodes as bioindicators of soil ecosystem health commenced in the 1970s and yielded valuable information through the application of traditional parameters such as species abundance and diversity (Yeates, 1970; Freckman, 1988; Wasilewska, 1997). However, the inception of the Maturity Index (MI) (Bongers, 1990), as well as its modifications (Yeates, 1994; Korthals et al., 1996), and the further development of NBIs by Ferris et al. (2001) and Ferris (2010), represented major contributions towards expanding the available toolset for studying the status of soil ecosystems.



Du Preez, G., *etal* (2022). Nematode-based indices in soil ecology: Application, utility, and future directions. *Soil Biology and Biochemistry 169: 108640.*

Nematodes as Bioindicators



adapted from Graham Stirling etal (2016)

qPCR Assay	Feeding Group
Dorylaimida	Omnivore
Mononchida	Predator
Aphelenchidae	Fungivore
Aphelenchoididae	Fungivore
Cephalobidae	Bacterivore
Mesorhabditidae	Bacterivore
Rhabditidae	Bacterivore
Panagrolaimidae	Bacterivore
Tylenchidae	Plant associate

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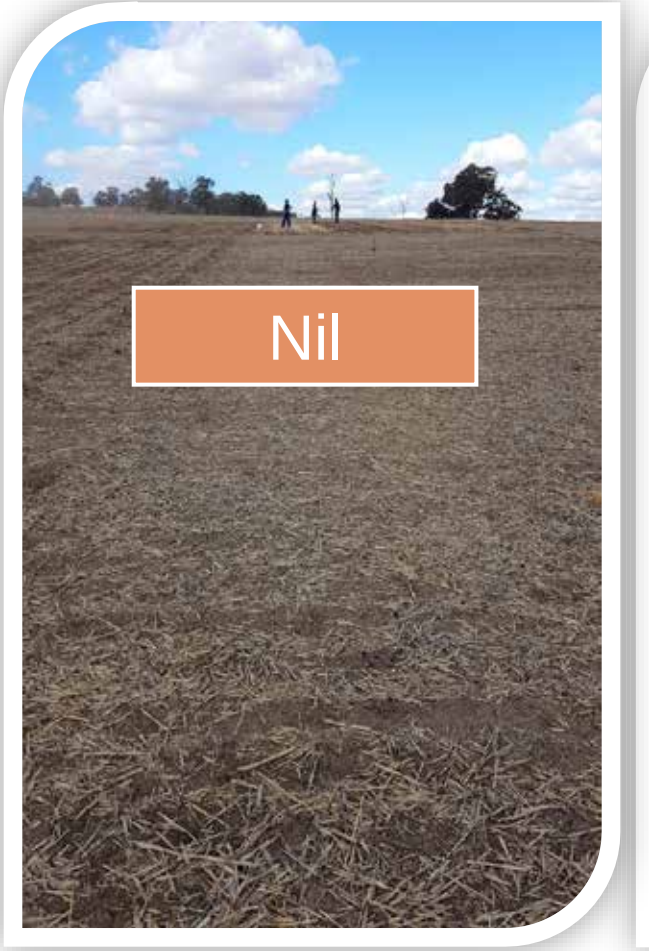
Mechanical amelioration

Working depth aim to 40cm



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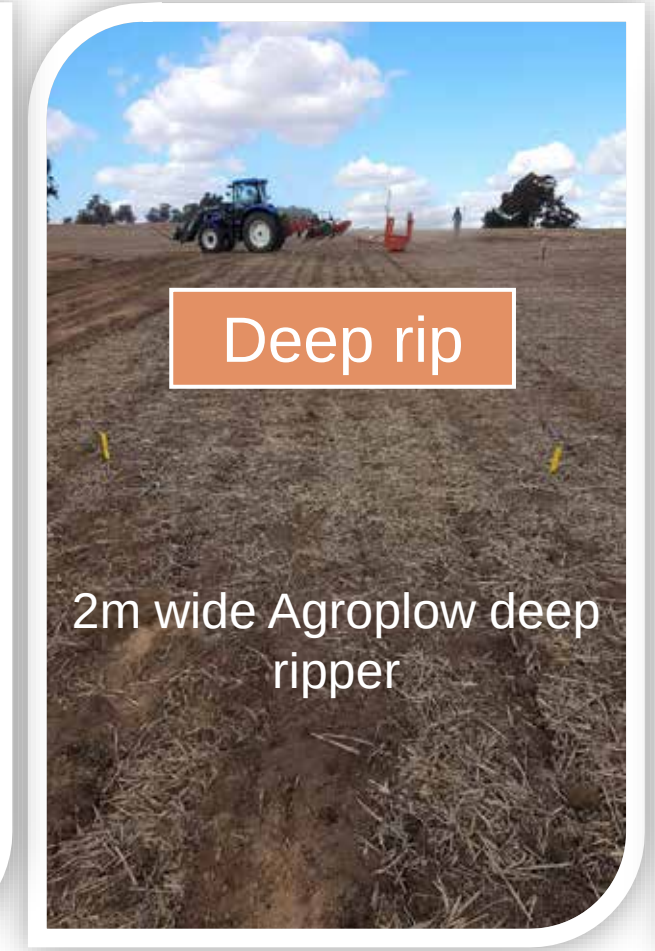
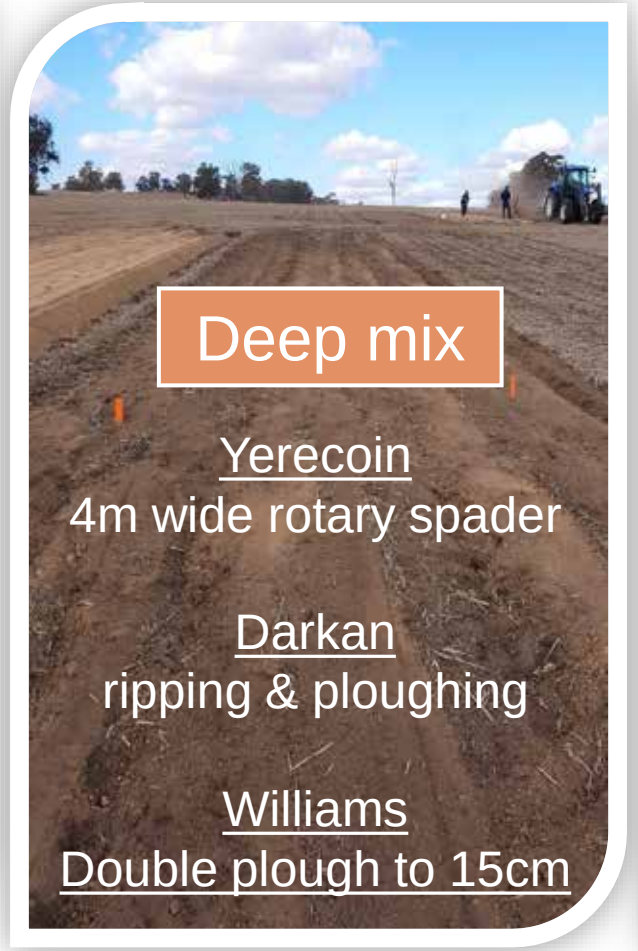


Deep rip

2m wide Agroplow deep ripper



Deep mix

Yerecoin
4m wide rotary spader

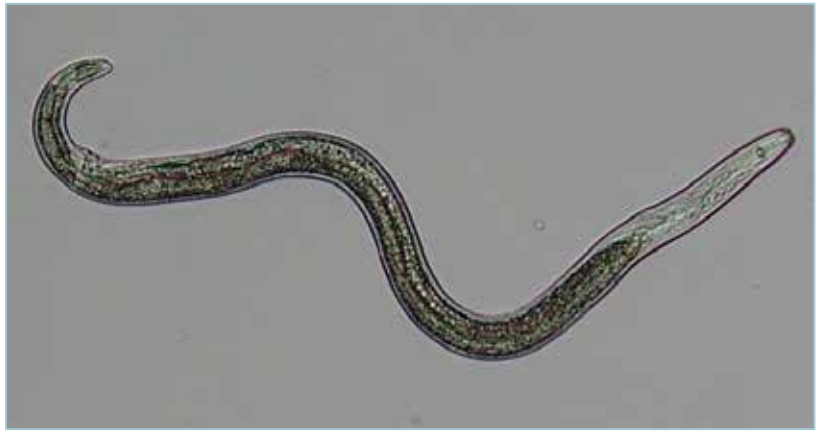
Darkan
ripping & ploughing

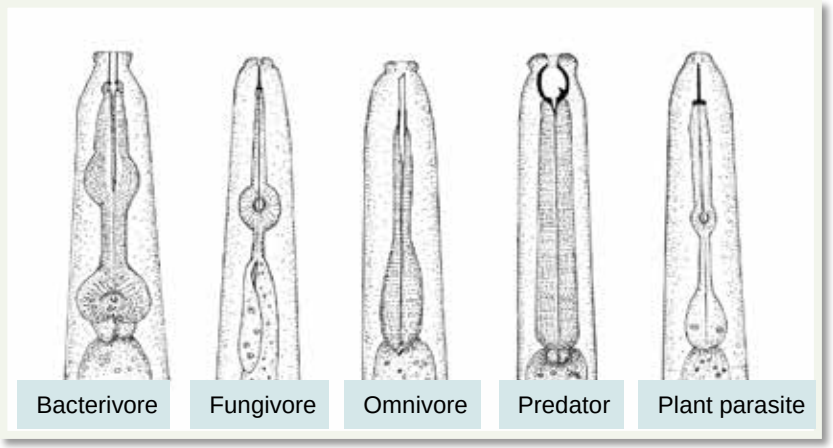
Williams
Double plough to 15cm

Inversion

3-furrow mouldboard plough

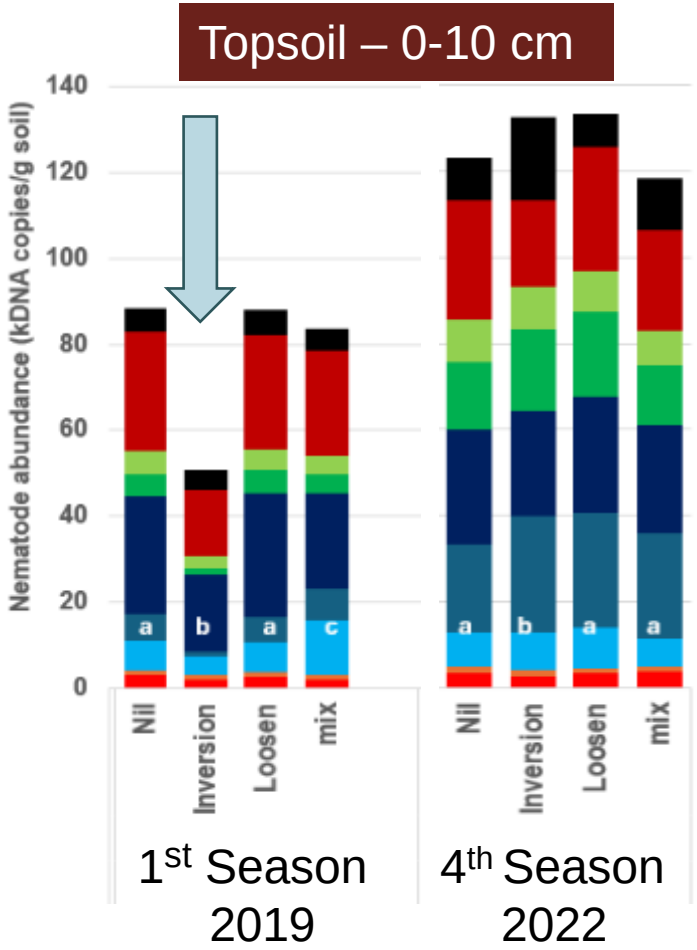
Biological characteristics investigated - 3 long term field trials





Rhizoctonia solani	Root lesion nematode	Soil biological diversity
Fungi – hyphal matt	Parasitic nematode - migratory	Nematodes as bioindicators Soil qPCR 9 DNA probes
Infection throughout season	Multiple lifecycles in season	Total bacterial abundance (Williams site)
In > 50-80% of broadacre cropping paddocks	In > 80% of broadacre cropping paddocks	Total fungal abundance (Williams site)
Susceptible - Cereals, oilseeds, some legumes & weeds	*Susceptible - Cereals, oilseeds, some legumes & weeds*	

Outcome: stimulated biological activity (nematode trophic groups)



High order nematodes → Fragile. Persisters. Complexity and structure developed → Maturing environment

Fungal feeding nematodes → Fungi active → C:N ratio low - moderate

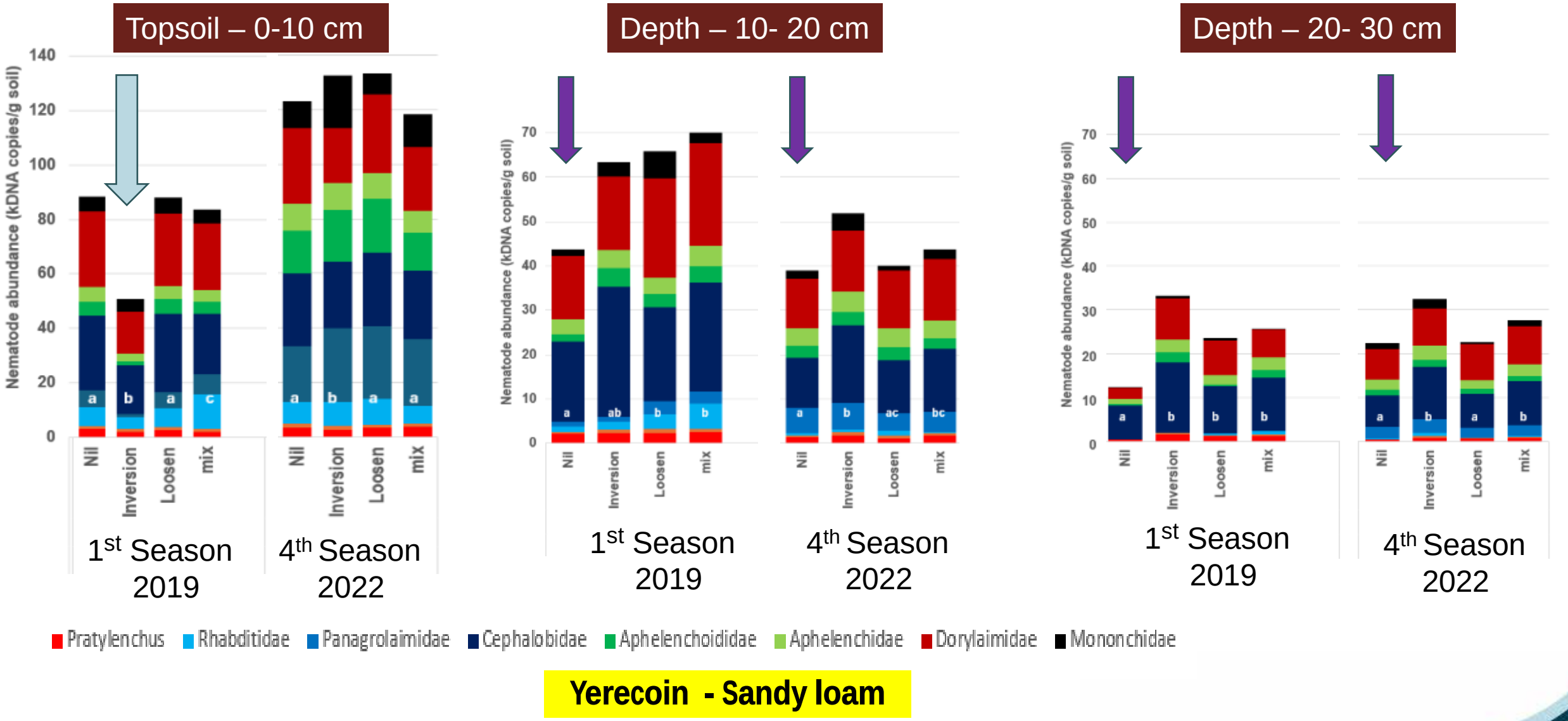
Bacterial feeding nematodes → Bacterial dominated environment – N enriched → Decomposition pathway – Faster OM breakdown. N-enriched

Plant parasitic nematodes

Pratylenchus Rhabditidae Panagrolaimidae Cephalobidae Aphelenchoididae Aphelenchidae Dorylaimidae Mononchidae

Yerecoin - Sandy loam

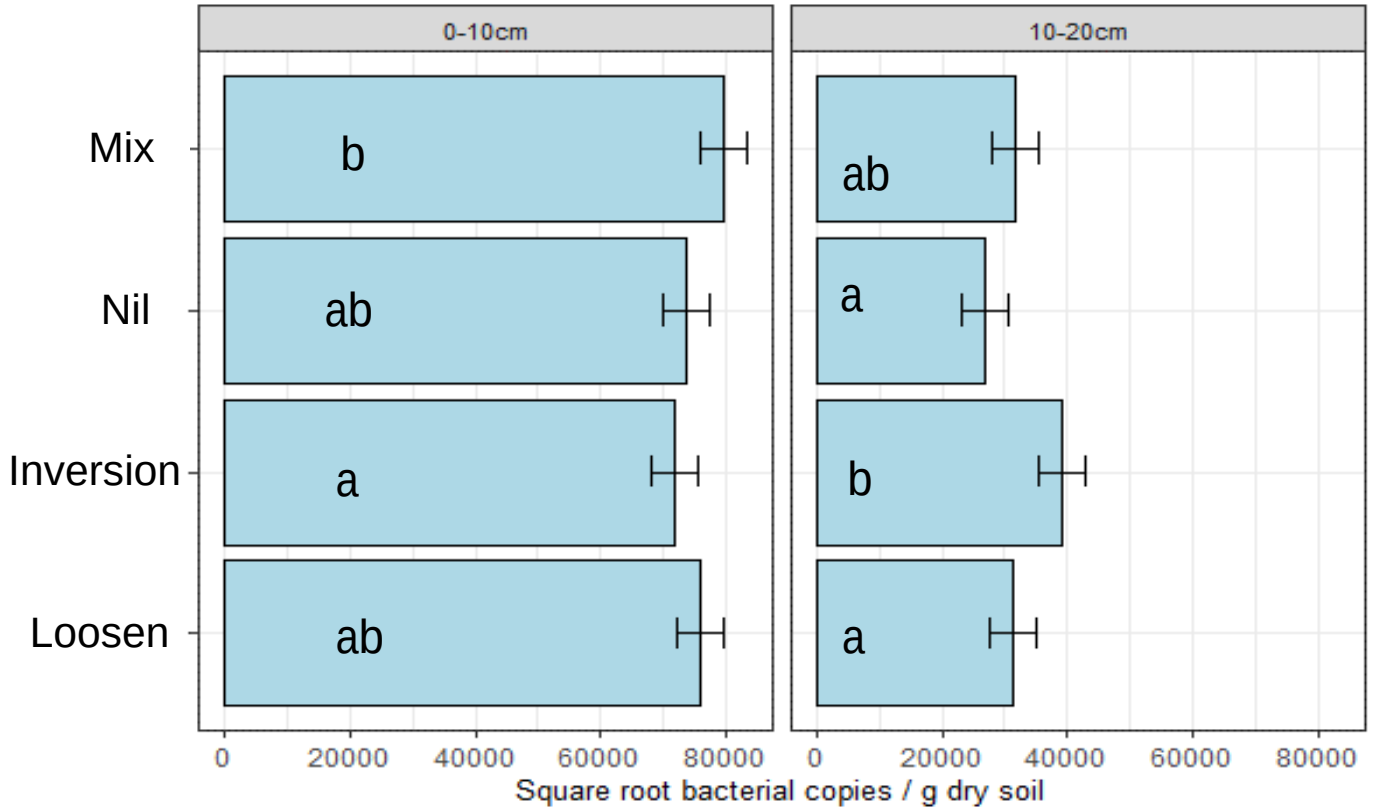
Outcome: stimulated biological activity (nematode trophic groups)



Yerecoin - Sandy loam

Outcome: stimulated biological activity (total bacteria)

Tillage X depth P < 0.001

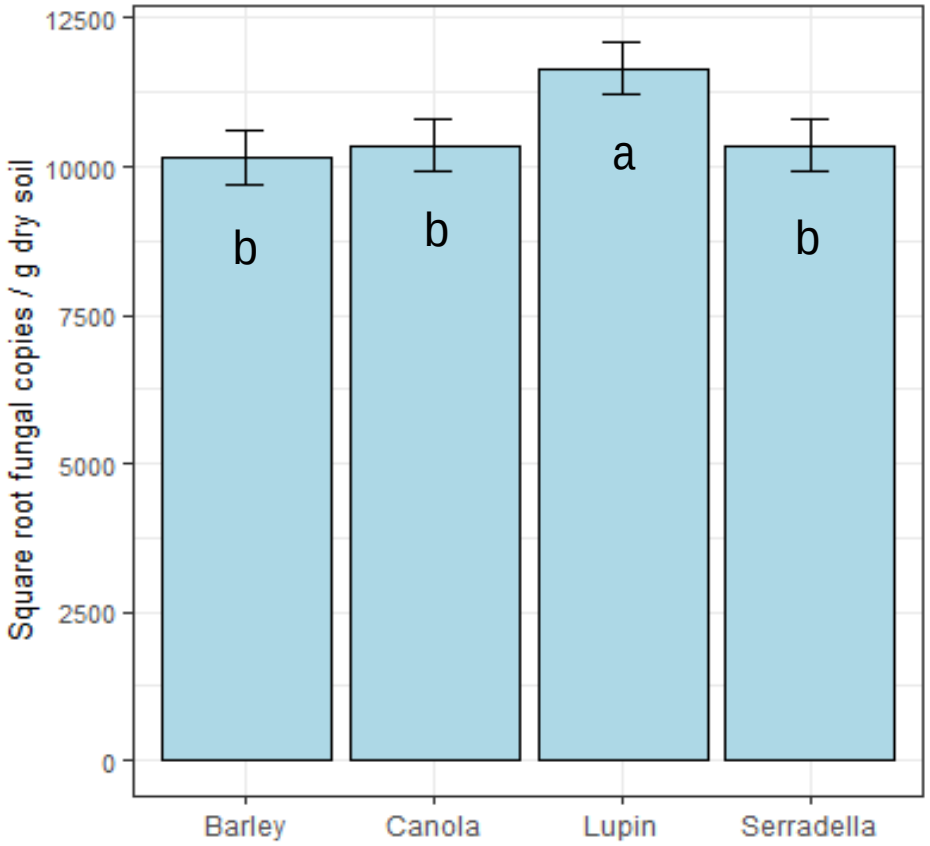


Williams – **Duplex sandy gravel**

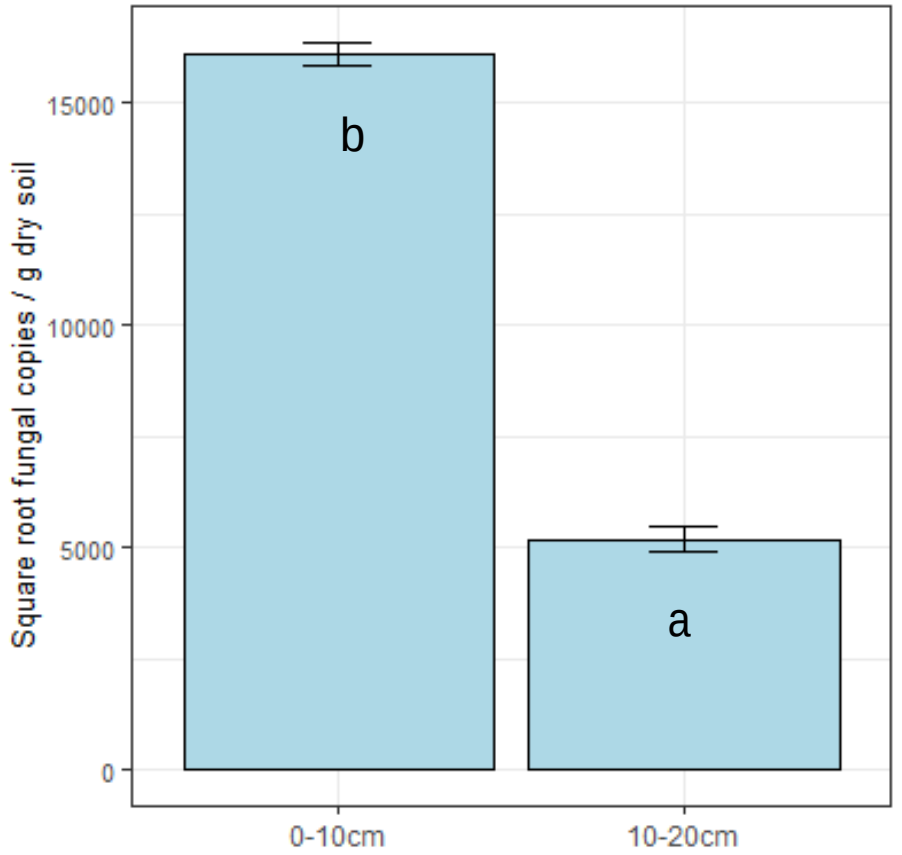
Bacterial abundance – EOS 2nd barley crop post tillage

Outcome: legacy effect of previous cropping

Crop P = 0.005 depth



Depth P < 0.001



Fungal abundance – EOS 2nd barley crop post tillage

Conclusions

Deep tillage **soil inversion**, biological activity bounced back in the topsoil (0-10cm) over time

Strategic tillage, **stimulated** biological activity at depth (10-30cm)

Susceptible **crop choices prior to deep tillage** impact root lesion nematode levels in barley crops for at least 2 years post tillage

Confidence in results, both Nematode Indices, Total bacterial and fungal abundance comparative and complimentary

Acknowledging collaboration

DPIRD

Crop protection - Sarah Collins, Carla Wilkinson, Daniel Huberli

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SARDI - Katherine Linsell

Thank you

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Important disclaimer

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