Department of Primary Industries and Regional Development

GOVERNMENT OF WESTERN AUSTRALIA

Protect
Grow
Innovate

Amelioration impacts on soil health and weed management, electric and summer weed control

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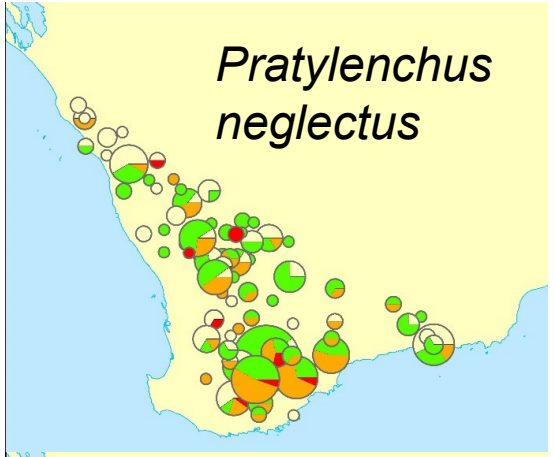
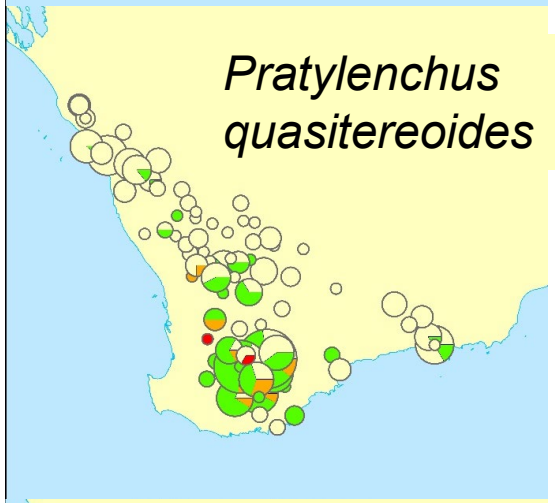
Deep soil tillage improves soil biology

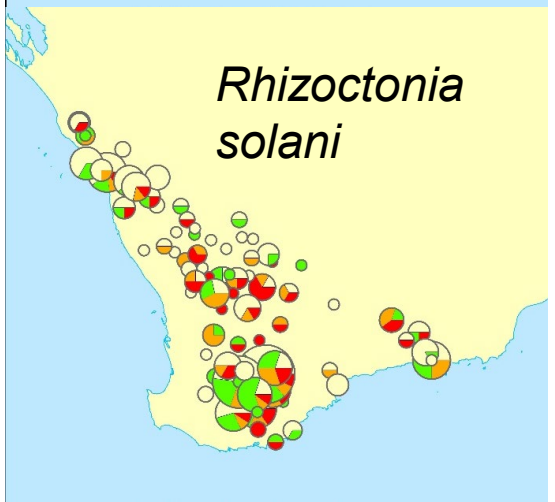
Sarah Collins, Carla Wilkinson and Daniel Hüberli

Benefits of deep soil tillage for central region where soilborne impacts are recognised

- Choices for amelioration that best suit major constraints of the region
- Expectations for success
- Manipulation of soilborne disease constraints prior to undertaking amelioration







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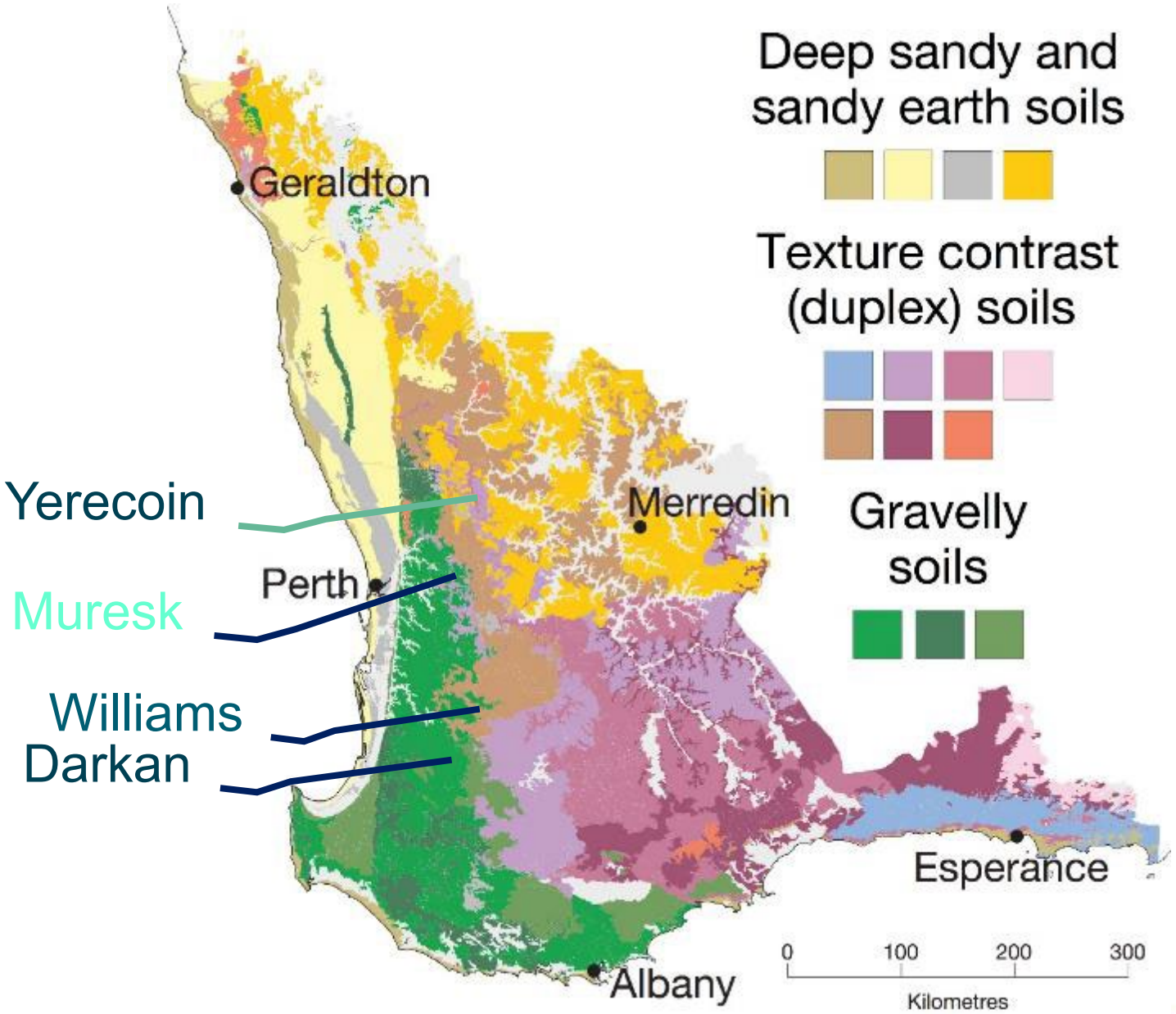
The basics for todays discussion

Q1. New profile – are soilborne disease issues alleviated?

Q2. New profile – does the soil's biology improve?

Q3. Does crop rotation prior to amelioration matter?

Representative experimental sites



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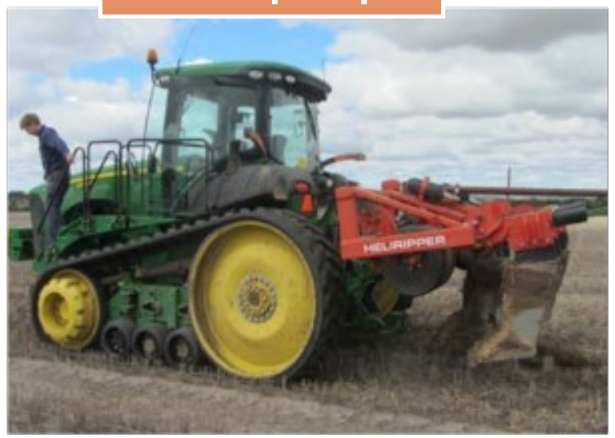
Q1. New profile – Are soilborne disease issues alleviated ?

Rhizoctonia solani
Fungi – hyphal matt
Infection throughout season
In > 50-80% of broadacre cropping paddocks
Susceptible - Cereals, oilseeds, some legumes & weeds

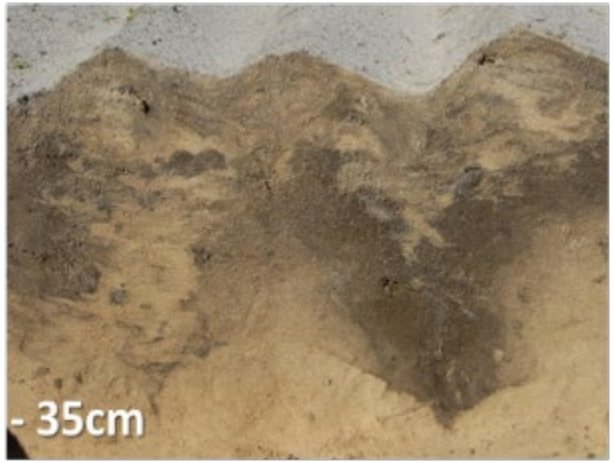
Root lesion nematode
Parasitic nematode - migratory
Multiple lifecycles in season
In > 80% of broadacre cropping paddocks
Susceptible - Cereals, oilseeds, some legumes & weeds

Deep tillage suited to soil type & physical constraints

Deep rip

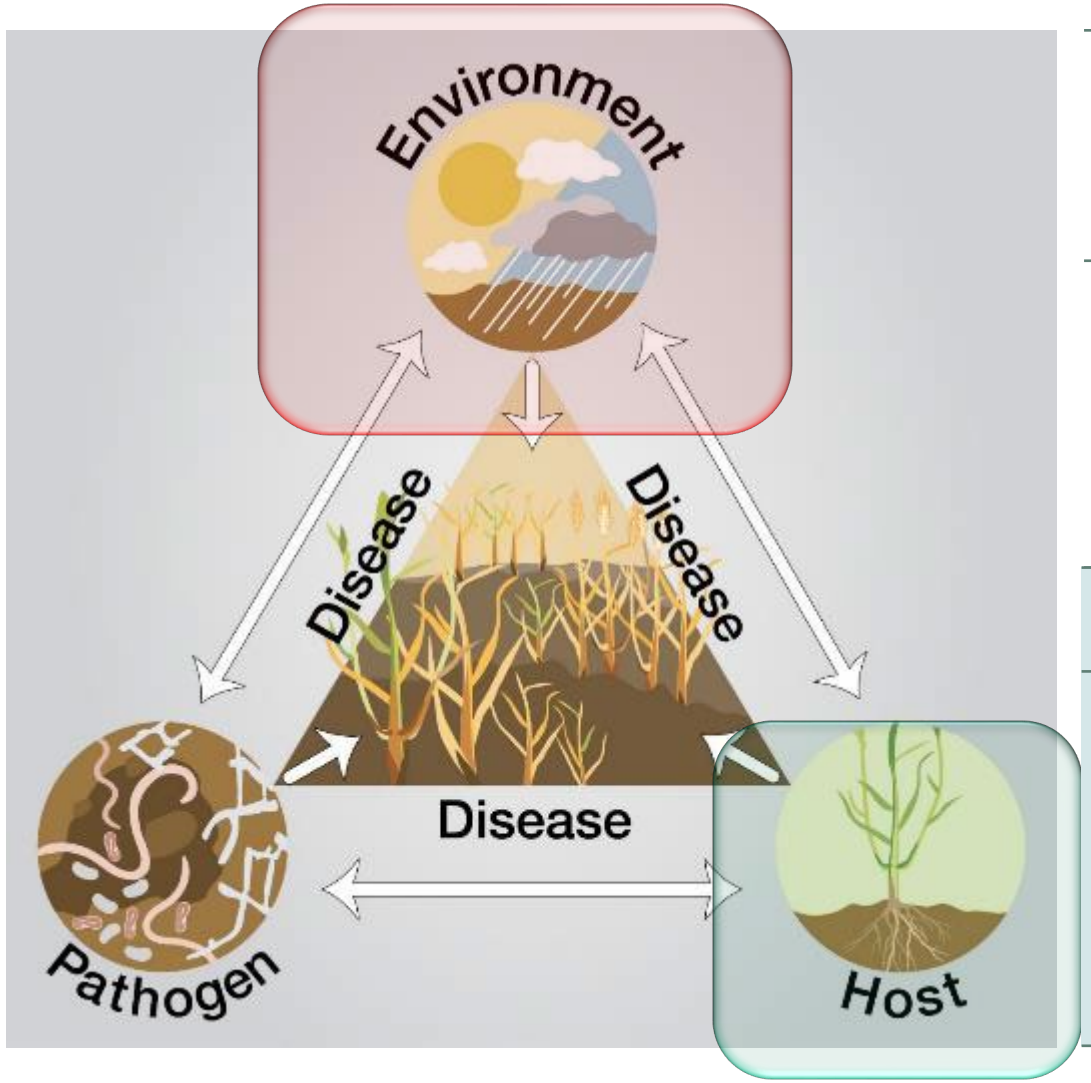


Soil mixing



Soil Inversion

New profile – Soilborne disease issues alleviated?

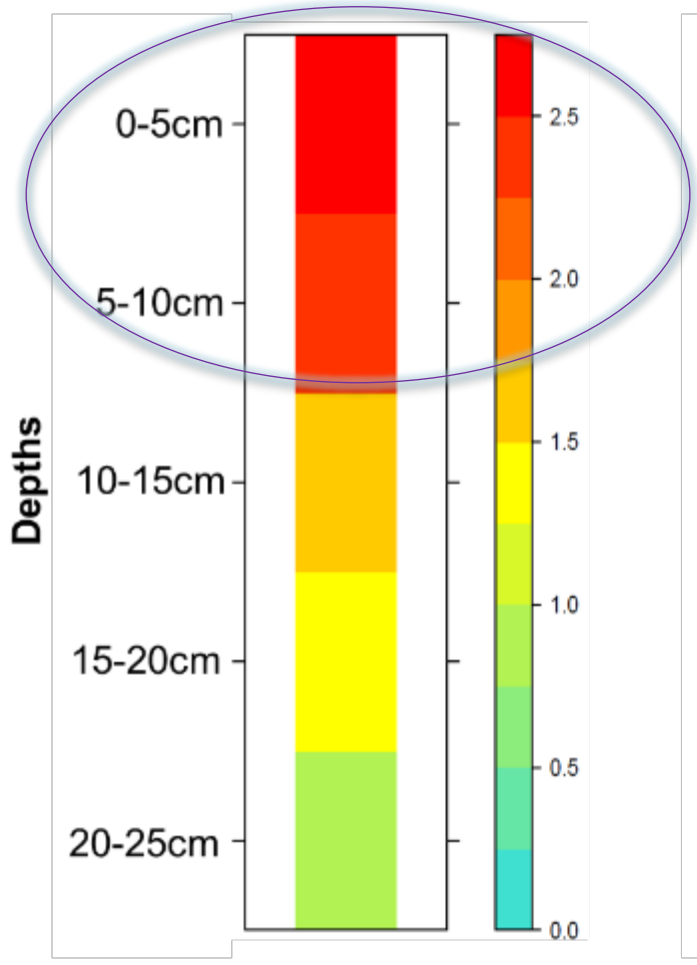


Darkan/ Yerecoin	Williams
2016 Canola	2016 Barley
2017 Barley	2017 Oats
2018 Oats	2018 Canola
2019 Barley	
2020 Wheat	
2021 Canola	2021 Barley
2022 Barley	2022 Barley

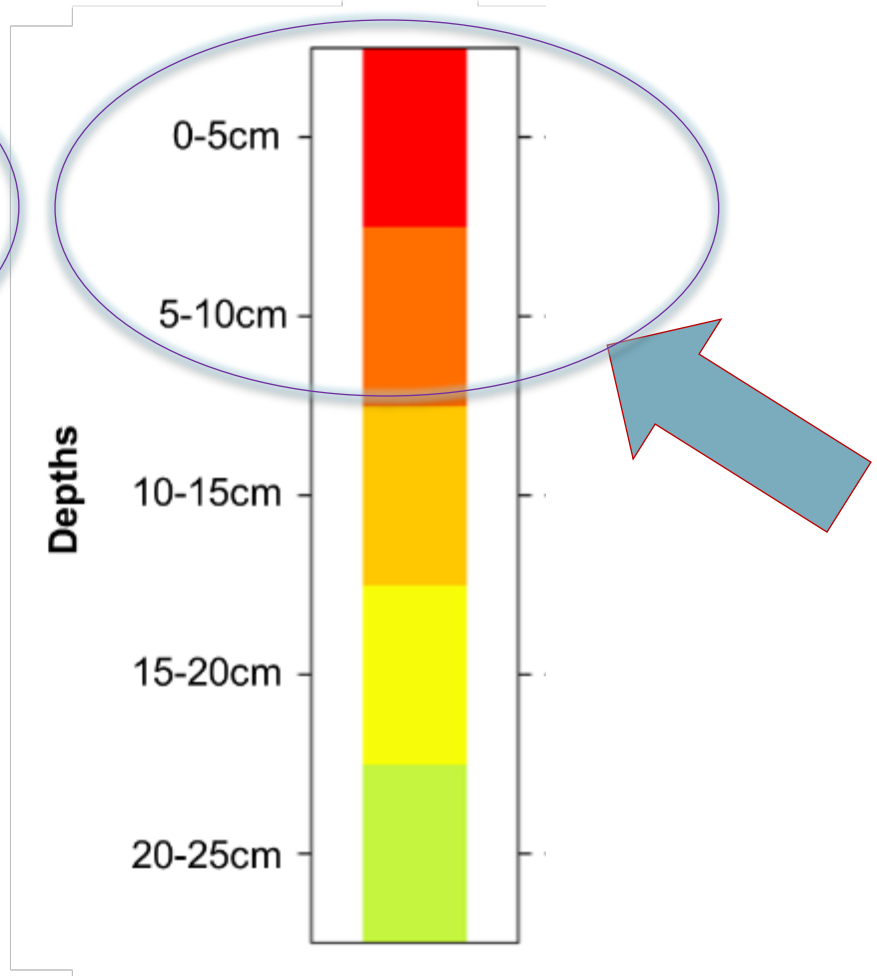
Soil Quality: 5 Soil Biology, [digital book]

Q.1 Relocating topsoil - The plant pathogens/parasites

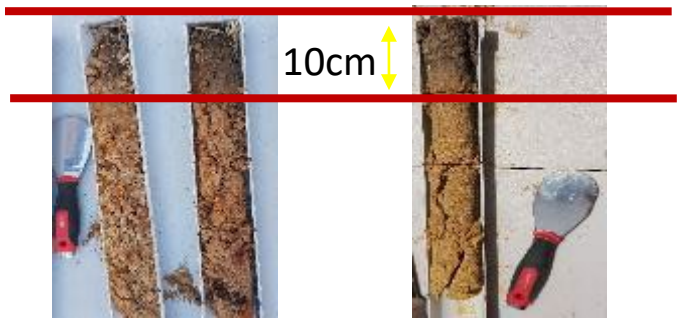
Rhizoctonia solani



RLN – *P. neglectus*



Topsoil post amelioration - Pathogen and nematode levels



Wheat yield RISK LEVELS USING PREDICTA B

LOW
MEDIUM
HIGH

Treatment	Nematodes and pathogen tested	Yerecoin - Sandy Duplex 2019	2020	2021
Nil (no amelioration)	***RLN*** *(P. neglectus)*			
	Rhizoctonia *solani* (AG8)			
		Wheat	barley	Canola

Topsoil post amelioration - Pathogen and nematode levels

Treatment	Nematodes and pathogen tested	Yerecoin - Sandy Duplex 2019	2020	2021
Nil	***RLN*** *(P. neglectus)*			
	Rhizoctonia *solani* (AG8)			
Soil Inversion	***RLN*** *(P. neglectus)*			
	Rhizoctonia *solani* (AG8)			
Soil Mixing	***RLN*** *(P. neglectus)*			
	Rhizoctonia *solani* (AG8)			
Deep Ripping	***RLN*** *(P. neglectus)*			
	Rhizoctonia *solani* (AG8)			
		Wheat	barley	Canola

Wheat yield RISK LEVELS USING PREDICTA B

- LOW
- MEDIUM
- HIGH

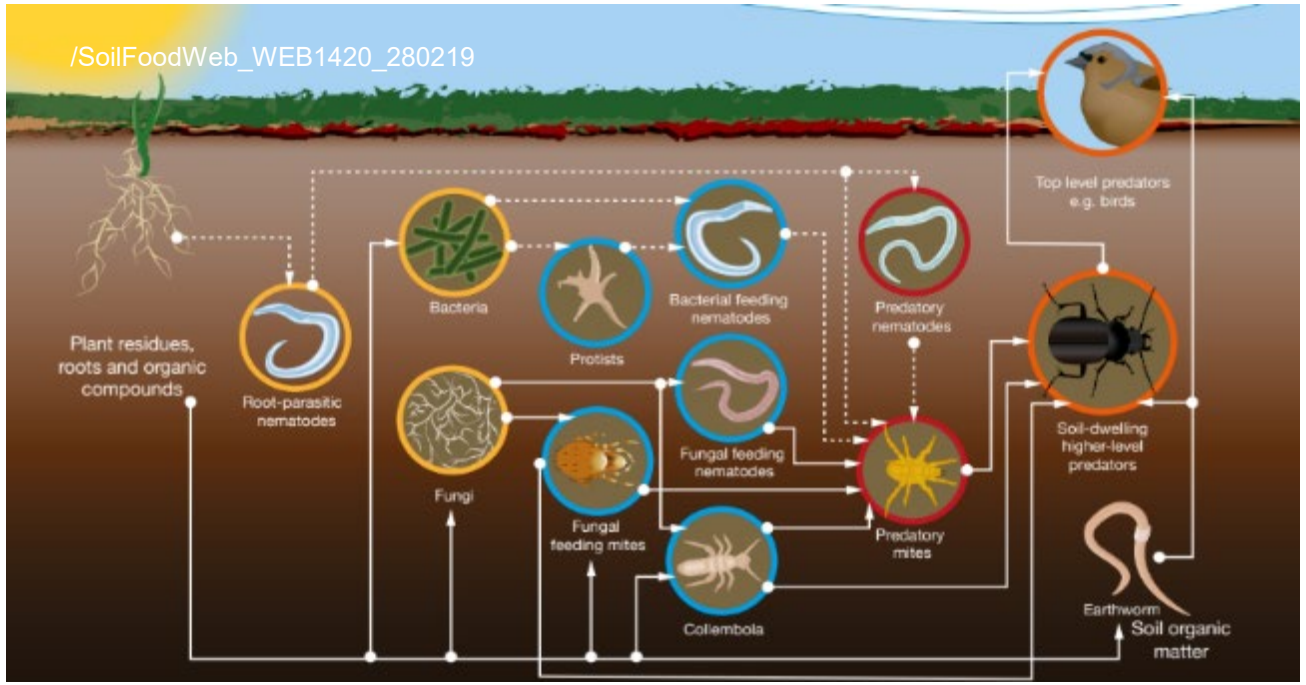
Third season post amelioration

Darkan and Yerecoin pathogen and nematode levels compared to Nil

Soil depth	*P. neglectus*	*P. quasitereoides* (Darkan only)	*R. solani*
0-10cm	Spade ↑	Inversion ↑	Inversion ↓
10-20 cm	Inversion ↑	Inversion ↑	Spade ↑
20-30 cm	Inversion ↑	Inversion ↑	Spade ↑

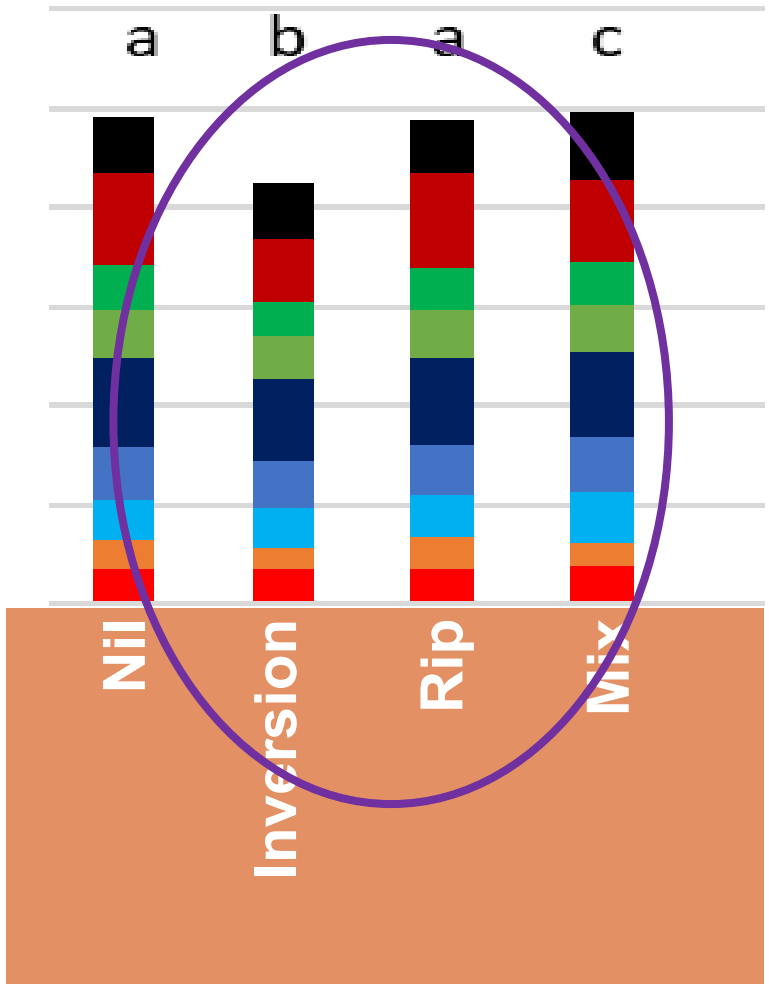
$p<0.1$

2. New profile – does the soil's biology improve?



Top 10 cm

Nematodes as the tool



Nematode Feeding Group
Omnivore
Predator
Fungivore
Fungivore
Bacterivore
Bacterivore
Bacterivore
Bacterivore
Cereal Cyst nematode
Root lesion nematode

Soil health

Structure

Enrichment and balance

Plant parasites

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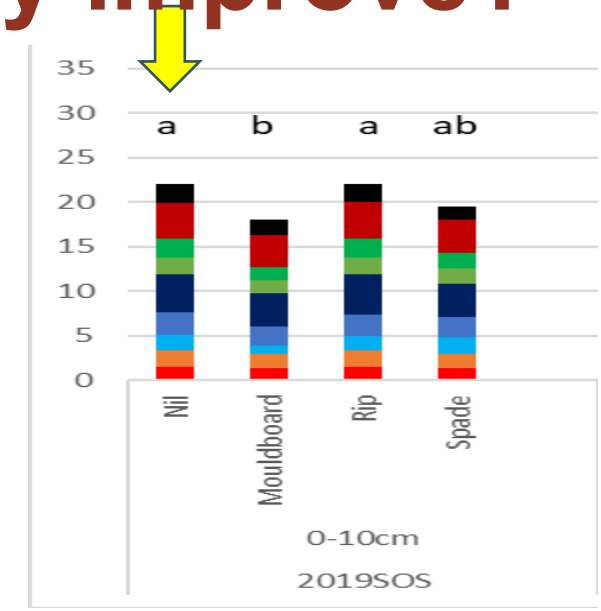
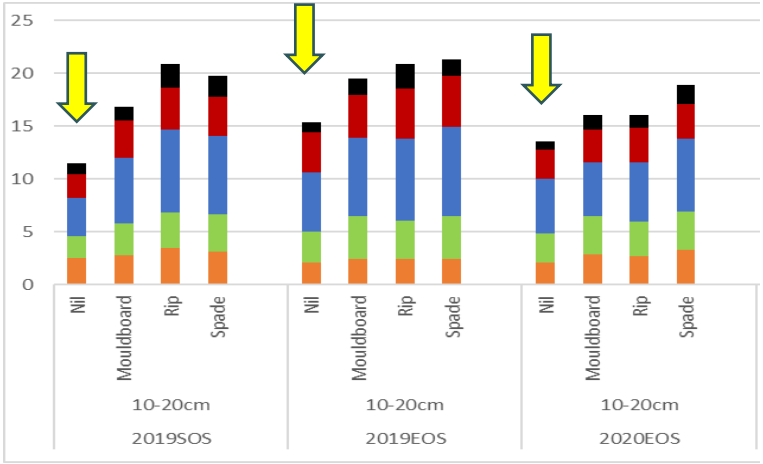
2. New profile – does the soil's biology improve?

1. <u>Topsoil</u> – directly post amelioration.
   - Inversion less
   - Microbial composition maintains structure and comparable diversity to nil



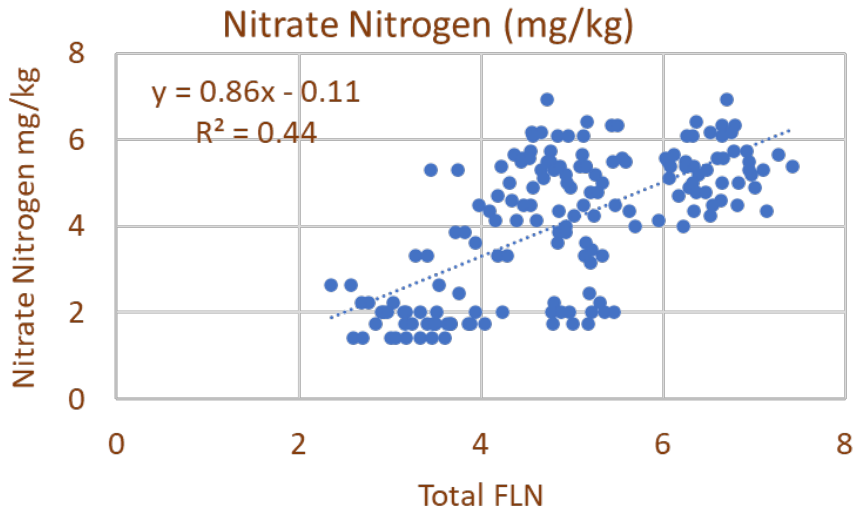
<u>2. Topsoil</u> - Changes to soil biology endure over time.
   - After 2 seasons cereal. Inversion and mixing differ from nil
   - 2021 Canola. Altered biology. Due to canola? Wet season?

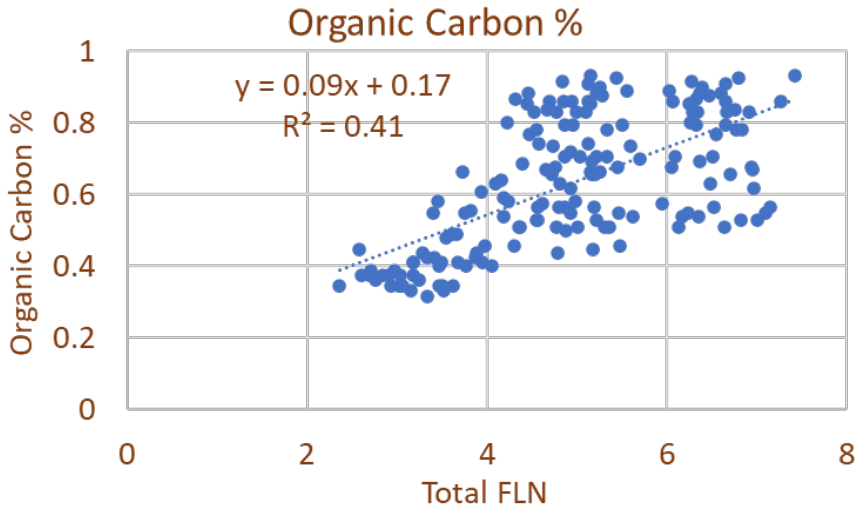
<u>3. Depth</u> - Changes to soil biology endure over time
   - Increased soil biology to depth
   - Enduring over time



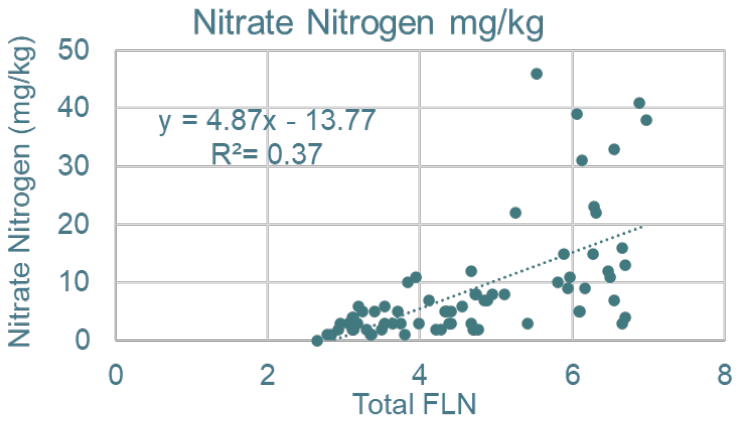
2. New profile –soil biology and chemistry relationships

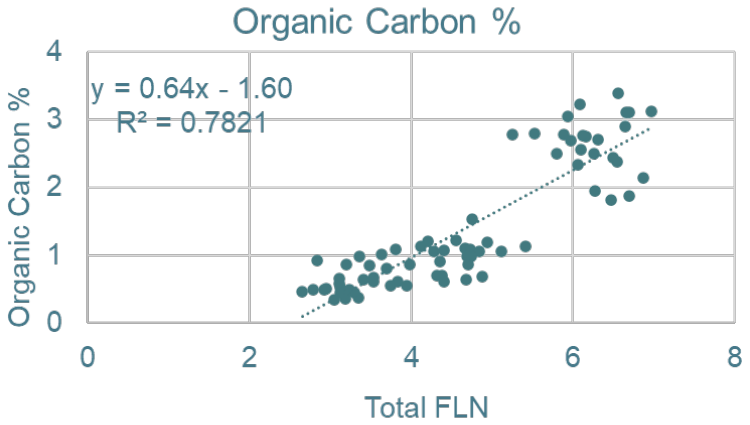
Yerecoin – Sandy loam

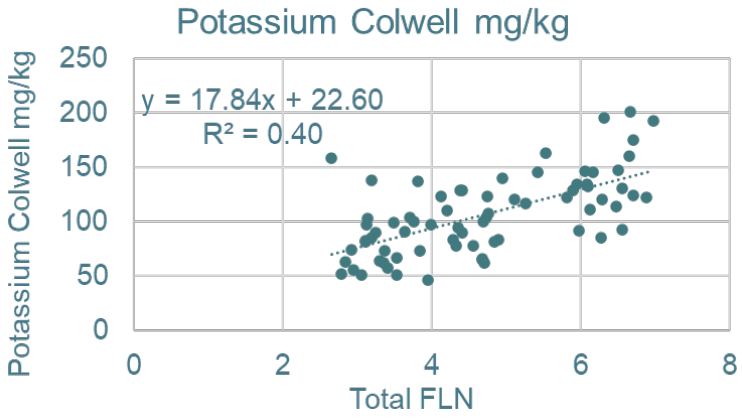




Williams – Duplex sandy gravel







Q3. Does crop rotation prior to amelioration matter?

Influence of 2019/20 crop and tillage treatment on barley (Maximus) yield

Previous crop/tillage	2021 Barley Yield (t/Ha)		Previous crop/tillage	2021 Barley Yield (t/Ha)	
Lupin	5.7	c	Inversion	5.1	b
Serradella	5.4	c	Deep Ripped	5.0	b
Canola	4.6	b	Plough	5.0	b
Barley	3.6	a	Nil	4.2	a

“Don’t treat our soils like dirt”

Summary

The effects of soil amelioration VARIED depending on organism, and tillage technique.

Soil inversion DECREASED soilborne pathogens and sometimes nematodes in the topsoil.

Soil amelioration INCREASED soilborne pathogens and nematodes 10-40cm depth where they don't usually occur in WA

Soil biology was STIMULATED amelioration process and ENDURING over time

WE HAVE MUCH MORE TO DO HERE

Thank you

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