Mouldboard ploughing at Muresk trial site. Image: Daniel Huberli, DPIRD.

Protecting WA crops

Issue #41

Date: July 2024

Contents

Soil amelioration and its impact on plant parasitic nematodes and Rhizoctonia

At a glance:

- Soil inversion using a mouldboard plough to invert the topsoil and reorder the profile was found in recent trials to be the most effective treatment for reduction of *Rhizoctonia solani* AG8 (*R. solani*), root lesion and cereal cyst nematodes (CCN).
- Mixing and loosening tillage treatments only resulted in a short-term reduction of the target organisms and based on these results would not be recommended as worthwhile long-term management strategies for paddocks infested with *R. solani*, CCN and or root lesion nematode (RLN).
- Rotation with canola in 2021 reduced *R. solani* population densities more than any of the deep tillage treatments and remains as one of the most cost-effective management strategies for this pathogen. The canola rotation also reduced CCN inoculum densities.
- The Grizzly plough reduced *R.solani* AG8 levels four-fold and increased grain yield by nearly 0.4 t/ha.

With a large area of deep, coarse textured soils, Western Australia (WA) is leading the way for uptake of strategic deep soil tillage as an amelioration practice. While the multiple benefits of deep tillage for abiotic soil constraints are now recognised, these amelioration practices are also likely to have major impacts on the living components of soil - its ‘biological’ community structure and functions.

A Department of Primary Industries and Regional Development (DPIRD) collaborative project between the Crop Protection group and the ‘Post Amelioration’ project within the Soils group, with co-investment from the Grains Research and Development Corporation (GRDC), has just been completed. The project, ‘Increasing farming system profitability and longevity of benefits following soil amelioration’, investigated the effects that soil amelioration had on the soil biology specifically root lesion nematodes and a soilborne disease.

The project ran for 4 years at 2 trial sites, Yerecoin (yellow sandy earth) and Darkan (duplex sandy loam). These sites were selected because they were impacted by mixed soilborne disease and pest issues, including the fungal pathogen *Rhizoctonia solani* AG8, root lesion nematodes (RLN) and cereal cyst nematodes (CCN, Yerecoin only). In 2019, 3 tillage methods were applied and compared to minimal tillage: deep ripping for soil loosening, spading for mixing and mouldboard ploughing for soil inversion.

The impact of strategic deep soil tillage on the density and distribution of soilborne pathogens and nematodes over time

Soil inversion was the most effective strategic tillage method for reducing *R. solani*, RLN and CCN over the length of the project. For 5 seasons post tillage at Yerecoin and 3 seasons at Darkan, *R. solani* densities remained lower than those in the minimal tillage treatment. RLN levels after inversion were lower for 3 seasons at Darkan but were only lower for the 1st and 5th growing seasons at Yerecoin. Inversion reduced CCN densities consistently across the four seasons, while loosening and mixing treatments did not differ significantly from the minimal tillage treatment.

Soil mixing reduced *R. solani* at both sites, but RLN densities were only reduced at the Yerecoin site in the first season post tillage.

Soil loosening also reduced *R. solani* densities for the 1st year post tillage at the Yerecoin site, but RLN densities were not significantly reduced by this treatment.

Further to the trials at Yerecoin and Darkan, a collaborative project between DPIRD, GRDC, the University of Adelaide and CSIRO established a trial site at Muresk in 2021 to compare the effects of inversion and soil loosening on *R. solani*. This trial had 2 crop types, barley and canola, in the first year of amelioration, followed by all barley in the year after amelioration. The site had a low-medium background of *R. solani* at the start of the trial.

By the end of 2022, the inversion treatment had significantly lowered *R. solani* densities in both the 0-10 cm and 10-20 cm soil profile compared to the control, but no difference was observed beyond 20 cm. *R.solani* densities were significantly lower in canola compared to the barley at both 0-10 cm and 10-20 cm depths.

Crop rotation and variety choice

DPIRD research scientists found that crop and variety choice had a significant impact on *R. solani* and CCN densities. CCN densities were reduced at Yerecoin when resistant La Trobe barley was sown in 2019 and also reduced when resistant canola was sown in 2021. As expected, *R. solani* density was reduced under canola at both sites.

Investigation of soilborne disease and nematode pest plant symptoms following deep soil tillage

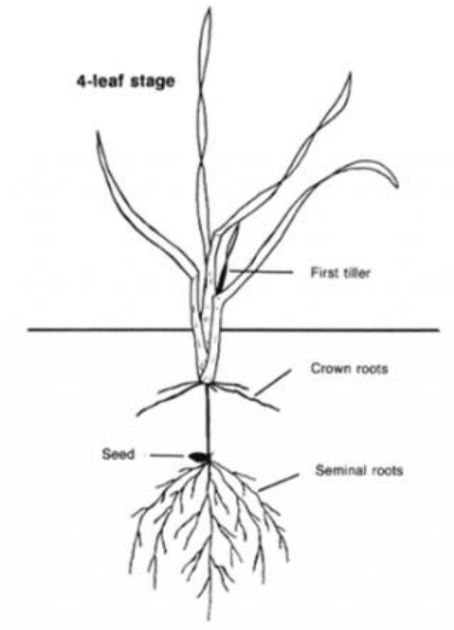
For soilborne diseases to occur, a conducive environment and susceptible host plants need to be present along with the pathogen or nematode pests. For soil biology, a conducive environment includes physical and chemical soil characteristics, soil moisture, and temperature. However, strategic tillage changes the soil environment and impacts disease occurrence.

To start the project, a qPCR soil test was used to identify the main soilborne pathogens and pests present at both trial sites and to measure their densities.

At Yerecoin, the main pathogen and pests were *R. solani* AG8, *Pratylenchus neglectus* (RLN) and *Heterodera australis* (CCN, formerly H. avenae).

At Darkan, there was *R. solani* AG8, *Pratylenchus neglectus* and *P. quasitereoides* (RLN).

To determine the impact that strategic tillage had on disease in crops, visual root health assessments of cereals (crown - upper lateral roots and seminal - deeper vertical roots) were recorded each year of the cereal phase.

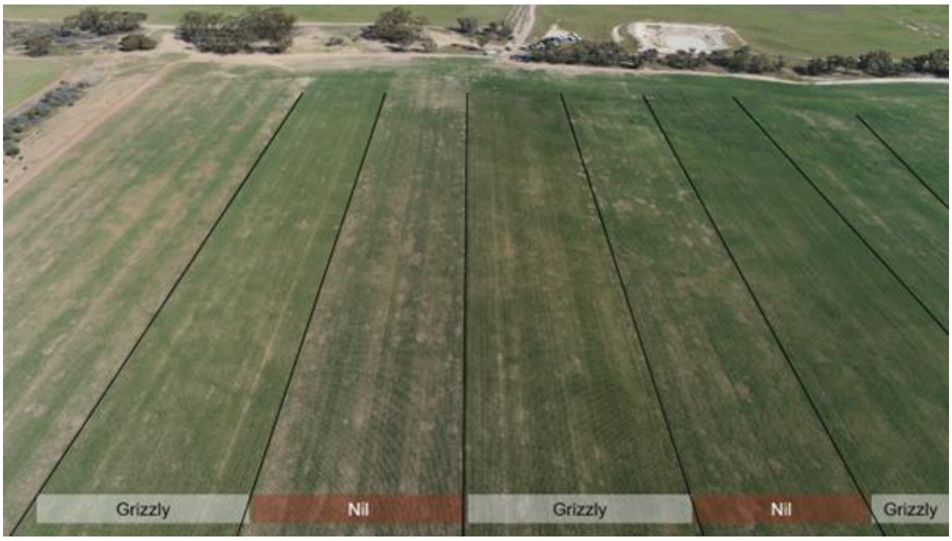


Wheat seedling at four leaf stage showing both crown and seminal roots. Image: DPIRD.

Root disease symptoms were found for all tillage treatments across the 3 seasons. In the sandy, gravel soils of Darkan, soil inversion reduced both crown root disease and seminal root disease expression in all 3 cereals crops grown. Lower root disease following inversion corresponded with significantly lower *R. solani* and RLN in the topsoil after inversion in 2019 and 2020.

In the yellow sandy soils at Yerecoin, no deep tillage treatment consistently reduced root disease symptoms. In the first season, soil mixing was the most successful treatment for reducing crown root disease, while in the second season, the inversion treatment resulted in less crown root disease symptoms.

Grizzly plough effect on Rhizoctonia solani AG8



Aerial image of the Grizzly plough trial at Muresk. Image: Veronika Crouch, CFIG.

Following DPIRD's research at Yerecoin and Darkan, a grower group demonstration trial by DPIRD, GRDC and the Corrigin Farm Improvement Group (CFIG) tested how a Grizzly plough affects *R. solani* AG8 soil densities in a farmer's paddock with medium to high levels of background *R. solani.* In areas of the paddock with high *R. solani* pathogen levels, the plough reduced these levels fourfold immediately after the treatment, and grain yield increased by nearly 0.4t/ha compared to the adjacent untreated area of the paddock.

DPIRD scientists found that the grizzly plough reduced root disease compared to the control treatments.

DPIRD extends its many thanks to all the growers that allowed their land to be used for these research trials.

Further information

For more information on root lesion nematodes and rhizoctonia refer to:

- DPIRD's Diagnosing root lesion nematodes in cereals webpage
- DPIRD's Diagnosing rhizoctonia root rot in cereals webpages
- GRDC's Rhizoctonia webpage
- GRDC's Root lesion nematode - Western fact sheet.

Meet Crop Protection team member – Alex Douglas

Originally from Canberra, Alex completed a degree in Rural Science from the University of New England in NSW before securing her first job with the Department on a 3 month contract.

Alex Douglas joined the weeds branch in Katanning in 1990, where she stayed until a couple of years ago when she moved to Albany. After 34 years with the department she has now decided to retire.

Alex's work focused predominantly on grass control in pastures, weed management in crop/pasture rotations, seed set control (spraytopping) in pastures, integrated weed management, and most recently, the biology and management of a few of WA's lesser known weeds like matricaria.

Alex also spent 10 years managing the weeds group before it was merged with other DPIRD research groups to create the Crop Protection portfolio.

Outside the department, Alex married Dale, a Woodanilling farmer, and they have 2 daughters, both of whom are now grown up and have left home.

Alex is looking forward to spending more time in her garden, taking her dog for long walks, enjoying holidays around the world, and might even get herself a horse. She will try not to identify every weed she sees along the way!