Soilborne Pathogen Identification and Management Strategies for Winter Cereals

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Aim

This project aims to provide growers with knowledge and experience in diagnosing soilborne pathogens from symptom expression on plant roots. It will also provide them with knowledge of management of these pathogens. This project demonstrates some management options in field situations and delivers extension activities nationally.

Background

Soilborne diseases remain an important constraint to grain crop production in Australia, estimated to cost grain growers over $370 million each year. Common diseases in the Western region include rhizoctonia bare patch, crown rot, root lesion nematode, cereal cyst nematode, and take-all. Irrespective of the disease, any pathogen that affects the roots, ultimately limits the uptake of water and nutrients and is, therefore, an important contributor to the yield gap.

Despite the significance of the issue, diagnosing plant diseases and particularly those caused by soilborne pathogens can be difficult. Growers mostly rely on above-ground symptoms, which is problematic as diseases are hard to distinguish from each other, other crop issues, and the change in farming practice to early sowing has minimised in-season expression.

The three treatments for this trial were implemented in 2021 including T1: brown manured field peas, T2: Uniform fungicide in-furrow, T3: pre-seeding deep ripping, and T4 was an untreated control plot. The 2021 wheat (Mace) yields were: 3 t/ha (T2), 2.3 t/ha (T3), and 2.8 t/ha (control).

In 2022, the site was sown with Scepter wheat, with the aim of gaining a better understanding of the impacts of these treatments in the second year following their application.

Trial Details

Trial location	Hyde property, Dalwallinu		
Plot size & replication	36 m x 100 m, not replicated		
Soil type	Red loam		
Paddock rotation	2017: Field peas	2019: Barley	2021: Treatments
	2018: Wheat	2020: Fallow	2022: Wheat (Scepter)
Sowing date	01/06/2022		
Sowing rate	65 kg/ha Scepter wheat		
Fertiliser	01/06/2022 - Flexi 40 L/ha, Map Zn 60 kg/ha 16/06/2022 - Urea: 60 kg/ha		
Herbicides, Insecticides & Fungicides	13/05/2022: 2 L/ha Treflan, 2.5 L/ha Boxer Gold 27/05/2022: Trident 1 L/ha 01/06/2022: 400 mL/ha Flutriafol		
Harvest date	10/01/2023		

Treatments implemented in 2021

T1: Pea (Twilight) – Brown manured field pea crop

T2: Wheat (Mace) – Fungicide (Uniform) applied in-furrow

T3: Wheat (Mace) – Pre-seeding deep ripping

T4: Wheat (Mace) – Control

2021 Soil composition

Depth (cm)	pH ($CaCl_2$)	N (NO_3) (mg/kg)	N (NH_4) (mg/kg)	Col P (mg/kg)	Col K (mg/kg)	KCl S (mg/kg)	EC (ds/m)	OC (%)	PBI
0-10	8.2	9	2	31	359	3.7	0.186	0.79	98.3
10-20	9.2	6	< 1	8	175	5.6	0.230	0.57	154.8
20-30	9.2	2	2	13	246	14.0	0.294	0.68	137.7
30-40	9.5	1	2	12	246	30.9	0.414	0.49	139.5

Results

Plant establishment was reduced in Treatment 1 where wheat was sown into brown manured field pea stubble (Fig 1).

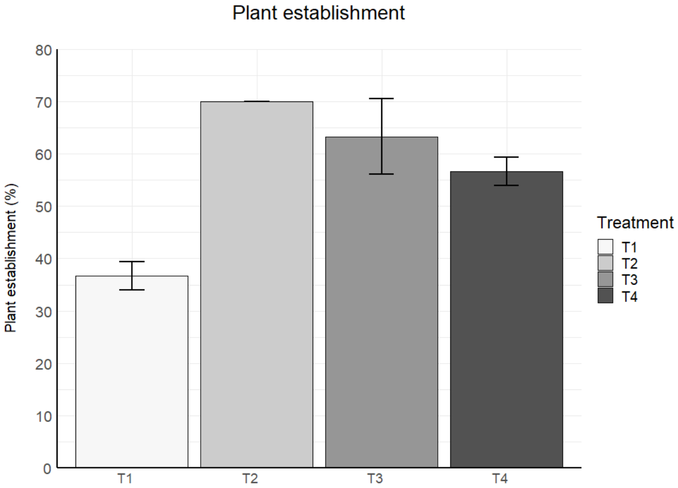

Figure 1. Plant establishment for each of the four treatments 6 weeks after sowing at the soil pathogen trial at the Hyde property, Dalwallinu.

Table 1. PREDICTA B results from treatments at the end of the 2021. Soil was sampled after crop harvest on 2nd December 2021.

Treatments		Pathogens detected from PREDICTA B tests		
		Rhizoctonia solani DNA	Fusarium pseudograminearum DNA	Pratylenchus neglectus nematodes/ g soil
1	**Field peas**	10	14	13
2	**Uniform in-furrow**	4	71	24
3	**Deep ripping**	0	3536	5
4	**Control (untreated)**	55	1436	17

At the end of 2021, Rhizoctonia solani was present in all wheat plots and its density was highest in the control plot (55 pgDNA/g sample). Fusarium pseudograminearum was present in all plots and T3 had the highest density (3536 pgDNA/g sample). Root lesion nematode (Pratylenchus neglectus) numbers posed a medium risk to the crop and was highest in T2 (24.33 nematodes/g soil). Yellow leaf spot was present across all wheat plots, being highest in T2. (As Yellow leaf spot is a stubble borne disease and not a root borne pathogen this was not covered as part of the project). Macrophomina phaseolina was present in the field pea treatment with minimal levels on all other treatments (Table 1).

Table 2. Results of live plant sampling in August 2022. Samples were processed through DDLS.

Treatments		Rhizoctonia solani	Root lesion nematode (Pratylenchus neglectus/g of root)
1	Field peas	Not detected	3,935
2	Uniform in furrow	Detected	1,374
3	Deep Ripping	Detected	3,037
4	Control	Detected	3,188

Live plant sampling in August 2022, detected *Rhizoctonia Solani* was present in all plots except the field pea treatment and root lesion nematode present in all plots (Table 2). The number of root lesion nematodes is considered moderate and may cause an economic loss in yield of the crop. Treatment 2 had a low number of root lesion nematodes.

Table 3. PREDICTA B results from treatments at the end of the 2022. Soil was sampled on 20th December 2022 after wheat crop harvest.

Treatments	Pathogen levels detected and risk level for the following season from PREDICTA B tests		
	Rhizoctonia solani DNA	F. pseudograminearum DNA	Pratylenchus neglectus nematodes/ g soil
1. Field peas	12 (low)	8 (low)	**84 (high)**
2. Uniform in furrow	0 (below detection)	0 (below detection)	68 (high)
3. Deep Ripping	2 (below detection)	**34 (medium)**	21 (medium)
4. Control (untreated)	**42 (medium)**	2 (low)	53 (high)

PREDICTA B sample taken at the end of 2022 showed that as was the case last year, *R. solani* was highest in the control plot (42 pgDNA/g soil), with minimal presence in the deep ripped plot (T3) and in-furrow fungicide plot (T2). Some *R. solani* was detected in the field pea treatment (T1), despite not being detected in the live plant sampling earlier in the year.

There was less presence of *F. pseudograminearum* than last year, whilst nematode (*Pratylenchus neglectus*) numbers were higher than last year, particularly in the Field Pea stubble (T1) and in-furrow fungicide plot (T2).

Table 4. Grain yield and quality of wheat.

Treatment	2021 yield t/ha	2022 Yield t/ha	2022 Protein %	2022 Screenings %
1. Field Pea crop (2021)	-	2.3	7.1	1.16
2. Uniform In-Furrow Fungicide (2021)	3.0	2.1	7	1.48
3. Pre-Seeding Deep Ripping (2021)	2.3	2.3	7.1	1.31
4. Untreated Control	2.8	2.9	7.4	1.38

All treatments yielded above 2 t/ha, with T2, uniform in-furrow being the lowest yielding and T4, the untreated control being the highest yielding.

Pathologists' comments

It is important to note that PREDICTA B sampling detect the amount of pathogen and nematode present in the soil sample provided. This does not always translate to disease being expressed on the host plant. Predicta B is used as a guide.

Root lesion nematode management tools for broadacre cropping include variety choice in susceptible crops and rotations of resistant crops to reduce levels. Wheat variety Scepter is susceptible to root lesion nematode (RLN) species *P. neglectus* so the nematodes increased across all treatments in 2023 (WA 2023 Crop sowing Guide) and were detected during live plant root assessments conducted early in the season (Table 1). Utilizing field pea as a rotation option is a recommended management tool to reduce *P. neglectus*. Its unfortunate that the paddock was untrafficable for an extended period in the 2021 season which allowed weeds to proliferate. Many grass and broadleaf weed species are also susceptible to RLN which is the likely cause of the continued increase in levels over the 2021 and 2022 seasons. The *P. neglectus* levels recorded in all treatments would cause yield loss in a conducive season.

Fungicide Uniform is an established treatment to reduce *Rhizoctonia* root rot, particularly early in the season when plants are establishing (Huberli *et al*. 2015). Presence of the pathogen in roots in the season following fungicide treatment can be expected as Uniform does not eliminate the fungus.

Deep ripping is a tool to loosen compacted soil horizons to allow better water, nutrient and root penetration through the soil profile. DPIRD research suggests that this style of deep soil tillage is not effective for *Rhizoctonia* root rot or root lesion nematode management in infested paddocks (Muenda *et al.* 2020; Collins *et al*. 2021).

References

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Peer review

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