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GRDC: Investigating double break (stacked rotation) options

Location: Merredin

Previous Rotations:

Aim: This project investigates the use of double break crops to increase the yield of subsequent wheat crops in the Kwinana East and West port zones of the WA grain growing region through the use of field experimentation.

Background:

Including break crops into rotations with cereals can influence the nitrogen (N) dynamics of cropping systems (Peoples et al. 2001) and assist in the management of weeds and reduce disease incidence in crop rotations (Kirkegaard et al. 2008). However, the adoption of break crop rotations in WA by grain growers is low due to the low perceived profitability of these crops (Seymour et al. 2012).

This project involves a main trial site located in Merredin using a randomised block design in small plot layouts with 4 replicates and four demo sites, Calingiri, Bencubbin, Miling and Corrigin which are designed to use grower equipment. 2016 was the first year of the project with the sites being either in a canola or volunteer pasture rotation. This was used as the first break. In 2017 the second break crop was sown, these included lupins, chickpeas, canola, field peas and lentils. Unfortunately, 2017 was a drier growing season on average affecting the total amount of tonnes produced. The data in this report is from 2017 with the 2018 data being included a report in early 2019.

Rainfall:

Table 1. Comparison of the yearly rainfall data amount for the 2017 season for the demonstration and trial sites (bom,2018).

	Miling	Calingiri	Bencubbin	Corrigin	Merredin
Jan	93	72	52	47.8	32
Feb	36	61	49	122.2	53
Mar	31	27	22	39.6	21
Apr	0	1	3.8	6.4	4.8
May	8.5	16	7.3	13.6	28
Jun	6.7	29	2.5	27.4	5
Jul	44.4	78	31.2	47	35.9
Aug	58.5	74.4	53.2	59.8	47.6
Sep	28	40.8	30.4	36.2	48.2
Oct	10.5	12.7	17.4	38.6	25.6
Nov	9.5	13.6	9.8	13.4	10.8
Dec	7	11.4	4.9	16.2	4.4
Total (mm)	333	437	283	468	316
GSR (mm	157	252	146	229	195

The large amount of summer rainfall at most sites led to an increase in stored soil water available for crops during the growing season. Growing season rainfall, particularly for April and May, was very low at all sites and was considered a restriction for the growth and early establishment of the break crops.

Results:

Table 2. Comparison of legume grain yield of break crops at the demonstration and trial sites compared to wheat and canola for the 2017 season (where grown at the site). na = data not available.

	Jurien Lupins (t/ha)	Albus Lupins (t/ha)	Desi Chickpeas (t/ha)	Hurricane Lentils (t/ha)	Genesis Kabuli Chickpea (t/ha)	Field Peas (t/ha)	Oats (t/ha)	Wheat (t/ha)	RR Canola (t/ha)
Trial Site - Merredin				na	na	0.78	2.76	2.72	
Demo Site 1 - Miling	0.97		0.67	0.82				1.6	
Demo Site 2 - Bencubbin	1.42		1.07	0.59	0.6				0.6
Demo Site 3 - Calingiri	0.97			0.36					
Demo Site 4 - Corrigin		0.80	0.9	0.29		1.16			

At all sites, Jurien lupins had a higher grain yield compared to all other legumes and varied in a range of 0.97 t/ha to 1.42 t/ha. Striker chickpeas yielded closest to lupins at the Bencubbin site, achieving 75% of lupin yield, while at the Miling site, Hurricane lentils achieved 85% of lupin yield. However, Hurricane lentils only achieved 42% of lupin yield at Bencubbin, and 37% of lupin yield at Calingiri, while Kabuli chickpea only achieved 42% of lupin yield at Bencubbin. At the Corrigin site, Desi chickpeas and field peas were the best performing legumes, although lupins were not included as a comparison at this site. Hurricane lentils at the Corrigin site yielded only 0.29 t/ha due to not being able to be mechanically harvested at the site.

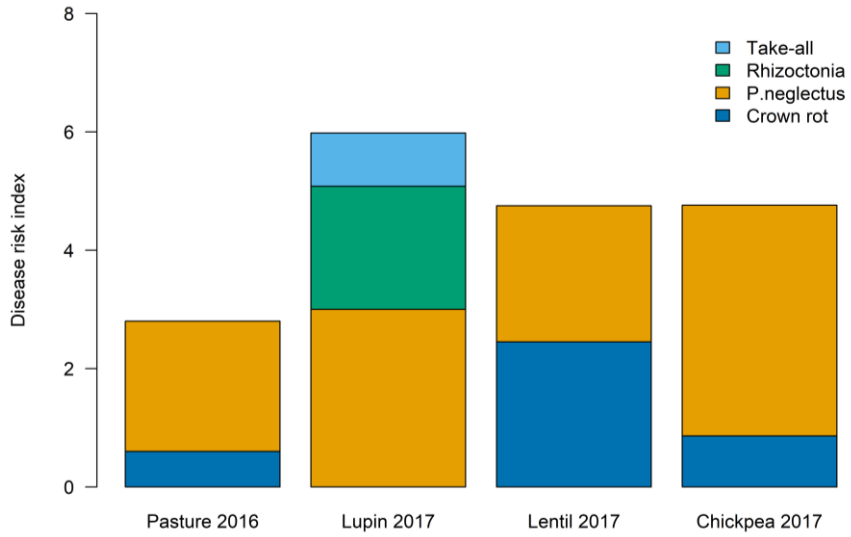

Figure 1. Root disease risk increased following a range of legume crops grown at the Miling site in 2017. PredictaB sampling was conducted at the start of the 2017 and 2018 seasons following volunteer pasture in 2016 and legume crops in 2017.

The dominant root disease constraint at the Miling site was ***Pratylenchus neglectus*** (*P.neglectus*, Figure 1), with a low amount of Crown rot present following a volunteer pasture in 2016. The levels

of these diseases increased after growing lupins, lentils, and chickpeas in this location in 2017. The lupins were most effective at reducing Crown rot compared to lentil and chickpea, however, there was a large increase in Rhizoctonia and Take-all. *P.neglectus* continues to be a yield constraint at this site for the 2018 season.

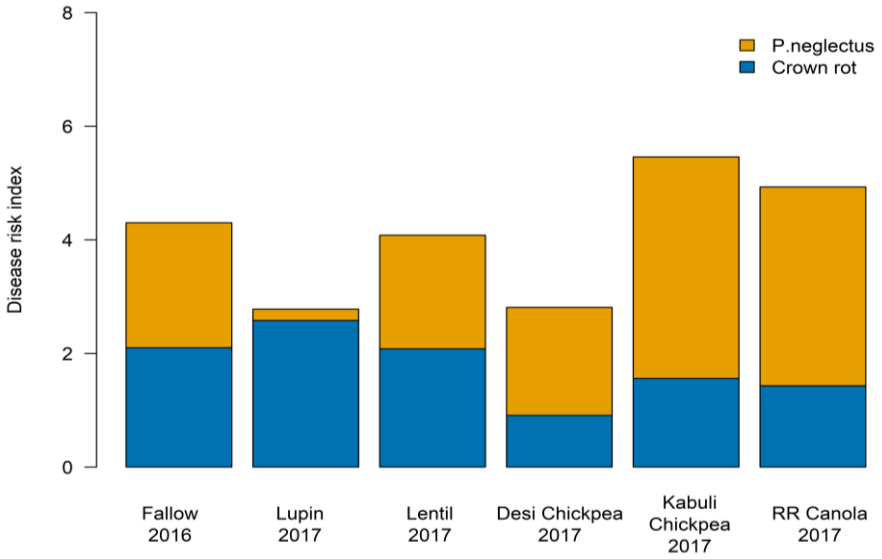

Figure 2. The change in disease risk following a range of legume crops grown at the Bencubbin site in 2017. PredictaB sampling was conducted at the start of the 2017 and 2018 seasons following each respective crop. Roundup Ready canola (RR Canola) was grown in the paddock around the demo sites and is included as a comparison.

The demonstration site at Bencubbin was a chemical fallow in 2016 prior to being sown to a wide range of legumes in 2017 (Figure 2). The dominant root disease constraints at this site were *P.neglectus* and Crown rot. This site highlights that lentils, chickpeas, and canola are all classified as susceptible to moderate hosts of *P.neglectus* and have maintained or increased the levels of this nematode in the soil. The resistance of lupins to *P.neglectus* can be seen to reduce the number of nematodes in the soil. There may be a trend in this data that the canola and chickpeas were better at reducing the levels of Crown rot at this site.

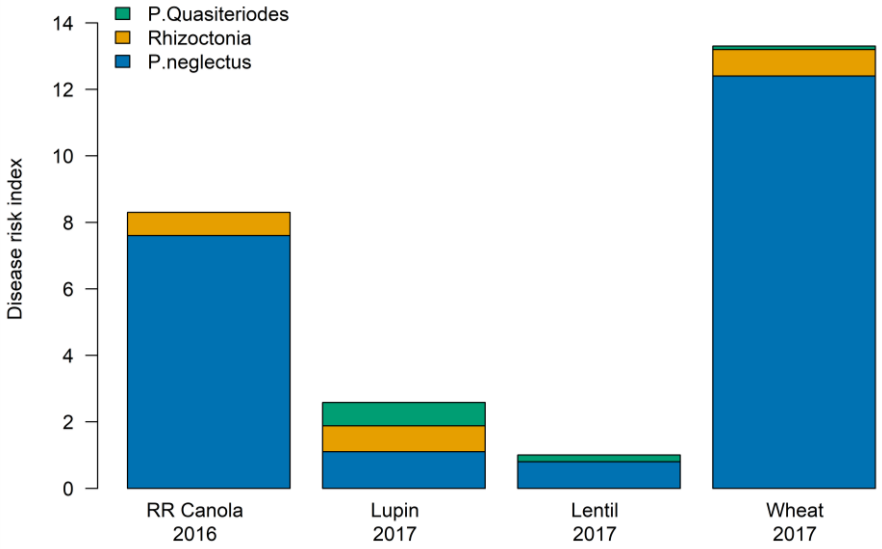

Figure 3. The change in disease risk following a range of legume crops following at the Calingiri site in 2017 following canola in 2016. PredictaB sampling was conducted at the start of the 2017 and 2018 seasons following each respective crop. Wheat was grown in the paddock around the demo site in 2017 and is included as a comparison.

The site at Calingiri was sown to Roundup Ready Canola (RR Canola) in 2016 prior to the demonstration site being established in 2017 (Figure 3), while the remaining portion of the paddock was sown to Wheat. The dominant root disease constraint at this site was *P. neglectus* following canola in 2016. This was greatly decreased by growing lupins and lentils, and greatly increased by growing wheat in 2017.

Figure 4. Root disease levels at the Corrigin site in 2017 following chemical fallow and before legume breaks crops were planted.

The amount of root disease present at the Corrigin site at the start of the 2017 season following a chemical fallow was low compared to other sites in this study (Figure 4). The 2018 results will be in the 2019 report.

Observations:

Even though lupins had a higher yield compared to the chickpeas and lentils, the value of chickpeas and lentils is normally significantly higher (at least double) compared to lupins. This means that the 15-25% yield penalty evident at these sites from growing chickpeas and lentils can be easily offset by the increase in value of the grain.

It has been shown that a double break can be effective at removing yield constraints where the break crop has been matched to the yield constraint. For example, lupin and lentil appear to be effective in reducing *P.neglectus* levels. However, where the break crop type has been mis-matched with the yield constraint, then they have not been effective in reducing disease risk. This is most evident with canola and chickpeas, where levels of *P.neglectus* generally increased following these crops.

2018 is the final year for the double break crop options trial, with all sites sown to wheat to assess the effectiveness of single and double break crops on the management of root disease yield constraints and weed control.