Increasing the Profitability of the Double Break Rotation in the MRZ of WA Wheatbelt through Incorporation of an Early Sown High Value Pulse

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Take Home Messages
- Grain yield was low across all high value legume treatments due to a combination of factors
- Attention to detail and good planning are essential to grow high value legumes in the region

Aim
1. Demonstrate that growing canola (with effective weed control options) followed by a high value legume (with higher economic value) can lead to an effective and profitable double break crop sequence. The contribution of an early sowing date versus a traditional sowing date to increase the profitability of these crops will also be evaluated.
2. Determine the economic value of growing canola followed by a high value legume, and the impact of this rotation on the grain yield and profitability of a cereal crop in the first year following the double break crop sequence.

Background
One of the constraints in the use of a single or double break crop sequence is that the gross margin of the most commonly used break crops are generally less than growing a cereal crop. As a result, break crops are used sparingly by growers in crop rotations with the aim of maintaining the most profitable sequence of crops while maintaining reasonable control of weeds and diseases. The short term decrease in economic return from growing a break crop is offset by the longer term benefits of decreased production costs and increase the productivity of cereal crops for many years following.

The most desired traits of a break crop are to be effective in controlling weeds and disease while also being profitable. Current highly effective break crop options of canola and lupin are rated as moderate to low profitability (respectively) by growers, while pasture phases or fallow period generally result in a low or negative gross margin. The integration of high value legumes such as chickpea or lentil have been successful in medium to low rainfall environments of Eastern Australia to improve crop rotation profitability while maintaining effective weed control.

Recent studies in WA found that profitable grain yields of both chickpea and lentil are achievable in the medium rainfall zone (MRZ) of the WA Wheatbelt. The impact of earlier sowing of these pulses has also been demonstrated to significantly increase the profitability of these high value legumes. The downside of high value legumes is that potentially these break crop options have less developed (and therefore less effective) weed management packages for the WA environment.

This project will deliver innovation to growers by demonstrating a double break crop sequence of canola followed by chickpea or lentil that increases both the effectiveness and profitability of break crop phases to increase the overall productivity and profitability of crop rotations in the MRZ of WA.

Trial Details

Trial location	Main Trial Site, Hirsch property, Latham
Plot size & replication	200m x 18.3m x 1 replication
Soil type	Red Gravely Loam
Paddock rotation	2017 Wheat, 2018 Wheat, 2019 TruFlex Canola
Sowing date	Treatment 1 - 07/04/2020 Treatment 2 - 07/04/2020 Treatment 3 - 28/05/2020 Treatment 4 - 28/05/2020 Treatment 5 - 28/05/2020
Sowing rate	Treatment 1 - 60 kg/ha, Sceptre wheat Treatment 2 - 110 kg/ha, Twilight chickpeas Treatment 3 - 110 kg/ha, Twilight chickpeas Treatment 4 - 12 kg/ha, Volga vetch Treatment 5 - 40 kg/ha, Kelpie lentil
Fertiliser	07/04/2020: 40 Kg/ha MAP
Herbicides, Insecticides & Fungicides	Treatment 1: 07/04/2020: 500 g/ha Propyzamide Treatments 2 - 5: 07/04/2020: 500 g/ha Propyzamide, 800 ml/ha Trifluralin, 250 ml/ha Chlorpyrifos, 23/07/2020: 250 g/ha Factor, 240 g/ha Clethodim
Growing season rainfall	149mm

Treatments

	Treatment
1	Control, wheat sown using growers best practice
2	Early sown Chickpeas
3	Late sown Chickpeas
4	Late sown Vetch
5	Late sown Lentils

Soil Composition

Depth (cm)	pH($CaCl_2$)	Col P (mg/kg)	Col K (mg/kg)	S (mg/kg)	N (NO_3) (mg/kg)	N (NH_4) (mg/kg)	EC (ds/m)	OC (%)
0-10	6.0	25	222	35.2	5	5	0.140	1.08
10-20	5.5	9	130	30.5	2	2	0.150	0.81
20-30	5.4	6	136	25.1	2	1	0.084	0.56

Results

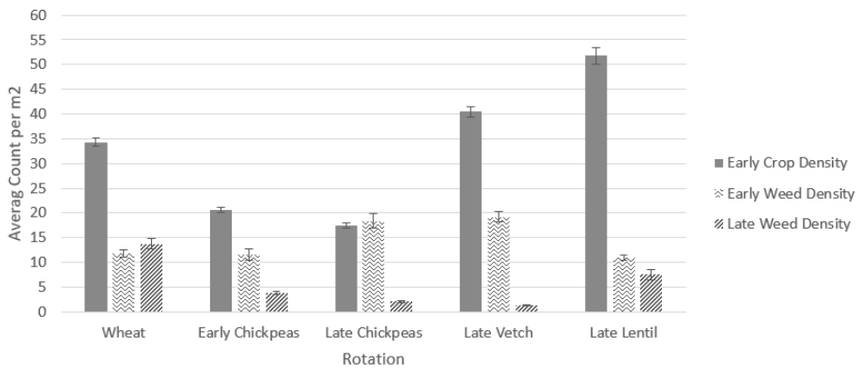

Figure 1: Average early (17/06/2020 or 23/06/2020) and late (19/08/2020) crop and weed density (per m^2) in various rotation options in the double break trial at Latham 2020. Error bars are ± 1 S.E.

Early sown treatments (Figure 1) were counted on the 17/06/2020, and late treatments were counted on the 23/06/2020 with the aim of comparing them while they were at comparative growth stage. Secondary weed counts were then taken across the site on the 19/08/2020.

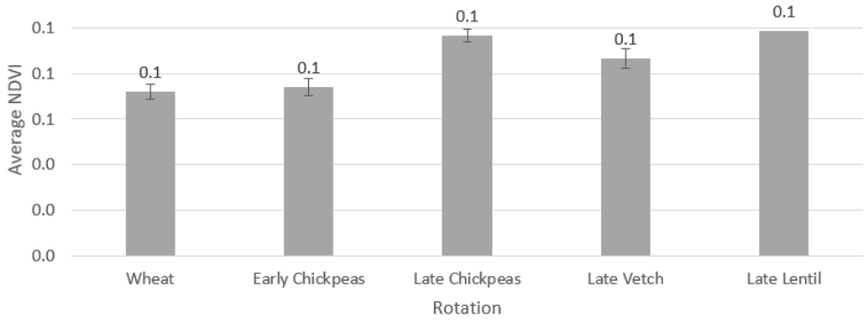

Figure 2: Average early (17/06/2020 or 23/06/2020) and late (19/08/2020) Average Normalized Difference Vegetation Index (NDVI) reading in various rotation options in the double break trial at Latham 2020. Error bars are ± 1 S.E.

The NDVI readings were taken at two different times, with the aim of measuring them at comparable growth stages. Early sown treatments (Figure 2) were measured on the 17/06/2020, and late treatments were measured on the 23/06/2020.

Comments

Both chickpeas were at the third node stage when early establishment counts occurred. Optimal plant density for Desi Chickpeas is considered 40-50 plants per square meter, but counts are well below that in both plots (14-22 plants/m^2) (Figure 1). The wheat was closer to the targeted plant population (50 plants/m^2) however also did not meet expectations. The vetch and lentils had a target density of 40-60 plants/m^2, but actual plant densities where just below at 34-56 plants/m^2. It is thought that wind damage from a major wind erosion event post seeding in early June and the subsequent row fill may be contributing factors, and that some seeding rates may not have been ideal leading to the lower than targeted plant densities across the trial.

Weed control was adequate across the site at the initial early observation, with weed numbers between 7 and 24 weeds/m^2 (Figure 1). There was some variation in number across the site and the weeds present predominantly comprised of rye grass and self-sown canola. Weed numbers had decreased in all legume rotations by the second, late, observation however weed numbers remained consistent in the wheat rotation.

Disease pressure was low at the site and no significant disease was recorded. Nodulation was not successful at the site, with all legume plots averaging a nodulation score below two. This may have significantly influenced the performance of the legumes overall, and will inhibit their value to the following years crop. Issues with inoculant delivery and soil pH have been highlighted as the cause of the lack of nodulation at the site.

Yield data has not been presented, as there was not significant grain mass to harvest in any of the legume treatments. Yields were initially expected to be low (less than 300 kg/ha) due to poor rainfall patterns in the area. The site was effected by a hail event on the 05/11/2020, which is estimated to have caused yield losses of between 80 and 100 percent. When harvest was attempted on the 18/12/2020, averages were below 10 kg/ha, which could not be accurately measured at that density, and were not representative of the trial performance.

Overall, the performance of all legumes onto the canola stubble was poor. They were not suited well enough to the seasonal conditions or paaddock to be able to present a potentially profitable crop this year. The Liebe Group will repeat the trial in 2021 with amendments to the site chosen and the methodology. The aim is to determine if any of the legume rotation options presented could potentially be profitable at a more suitable site.

Acknowledgements

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Peer review

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