Evaluating intercropping systems

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Key findings

- In 2019 and 2020 intercrops of field pea-canola (peaola) and chickpea-linseed did not increase the land use equivalent ratio (LER) above 1. This indicates intercrops were not able to improve crop productivity compared to the respective individual crops.
- Wheat sown after the 2019 cropping treatments yielded the same for all previous crops, ranging from 1.8 – 2.0 t/ha.

Why do the trial?

Intercropping is the practice of growing two grain crops in the same paddock. It is a production system adopted by a small number of farmers in dryland systems for its productivity and environmental benefits. Generally, intercrops are recognised for providing multiple benefits including resilience, weed and disease suppression and improved soil health. However, there is little research and information undertaken in Australia (Fletcher *et al.* 2016), to demonstrate the potential of these systems to be more productive than growing the components as monoculture (single crop per paddock).

The aim of this four-year trial is to assess the viability of integrating diverse species through intercropping into our current winter rotation options. We also examined whether these systems impacted the yields of a subsequent cereal crop.

How was it done?

2019			
Plot size	4.20 m x 36.0 m	**Fertiliser**	MAP (10:22) + 2% Zn @ 75 kg/ha Urea (46:0) @ 100 kg/ha (canola and canola + field pea only) Aug 6
Seeding date	May 28, 2019		
Location	Hart, SA		
Harvest date	November 26, 2019		
2020			
Plot size	4.20 m x 36.0 m	**Fertiliser**	MAP (10:22) + 2% Zn @ 80 kg/ha Urea (46:0) @ 100 kg/ha (canola and canola + field pea only) July 3
Seeding date	May 25, 2020		
Location	Hart, SA		
Harvest date	December 14, 2020		

The trial was a randomised complete block design. In 2019 there were six crop treatments within the trial including both monocrops and intercrops;

1. Canola (Stingray)
2. Field pea (Wharton)
3. Chickpea (Genesis090)
4. Linseed (Croxton)
5. Canola (Stingray) + Field pea (Wharton)
6. Chickpea (Genesis090) + Linseed (Croxton)

A standard knife-point plot seeder was modified to sow both the monocrop and intercrop treatments. The intercrop plots were sown in a double skip arrangement (Photo 1). That is, for treatment five (Photo 1) two rows of canola were sown next to two rows of field pea and repeated. In the following season (2020) all plots were sown with Scepter wheat to assess any carryover effects from the previous crop treatments.

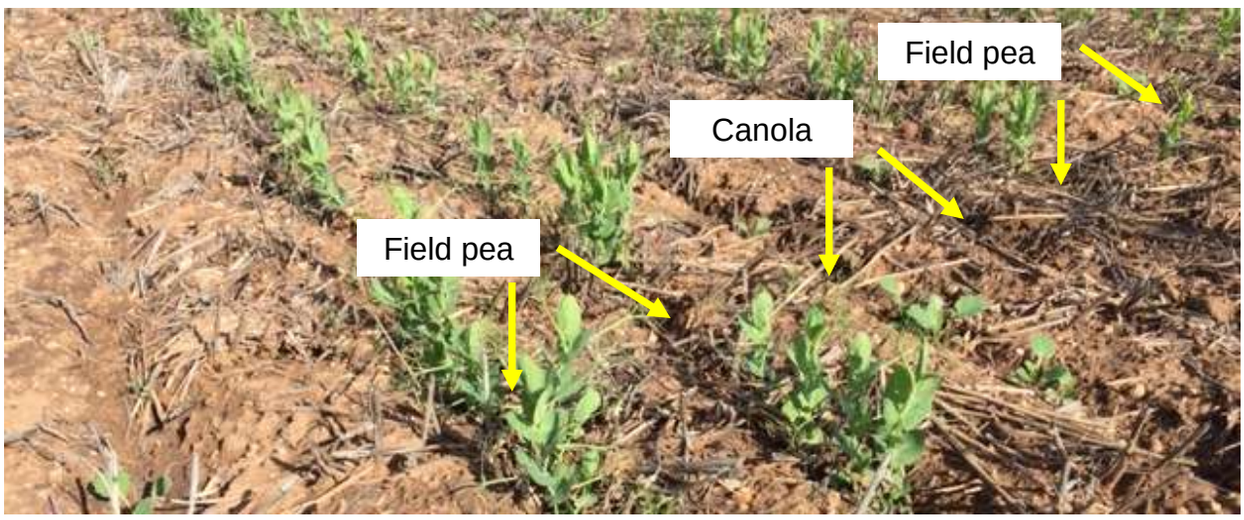

Photo 1. Canola and field pea intercrop (peaola) sown at Hart in double skip row arrangement.

Soil assessments

Soil moisture probes were installed on June 5, 2019. The configuration of the capacitance probes was EnviroPro 80 cm EP100GL-08's and contained sensors at 10 cm intervals, starting at 15 cm through to 85 cm. A total of 15 moisture probes were installed in all treatments (except the linseed monocrop) and replicates.

Plant assessments

Plant establishment counts and NDVI assessments were undertaken in all plots on July 24 and August 2 2019, respectively. Biomass cuts were completed on the same date for all treatments. The canola was at the end of flowering and field pea mid-pod fill. The chickpea was at the end of flowering and linseed had just started to flower. Cuts were completed by sampling 4 rows x 1 m sections in two areas of the plot. All samples were oven dried at 60°C for 48 hours and weighed.

All plots were harvested for grain yield. For intercrop treatments the whole plot grain sample was retained, sieved to separate seed sizes and weighed to calculate the individual crop yield.

Land equivalent ratio (LER)

LER values were calculated to give an indication of intercropping productivity relative to the monoculture treatments. The LER is expressed as: LER = (intercrop yield A / sole yield A) + (intercrop yield B / sole yield B).

An LER value of 1.0 means the productivity of the intercrop was equivalent to the monoculture components. An LER value of <1.0 means the productivity of the intercrop is lower than the monoculture components, while an LER value >1.0 means the intercrop is more productive than the monoculture components and is referred to as 'over-yielding'.

Results and discussion

NDVI and Biomass

In early August NDVI was highest in linseed followed by canola. Other treatments including the intercrop of chickpea-linseed and canola-field pea (peaola) produced similar canopy cover (Figure 1). Chickpea, linseed and their intercrop had similar biomass accumulation patterns at pod filling (Figure 1). Biomass accumulation was greater in field pea than canola with the peaola yielding an intermediate biomass (Figure 1).

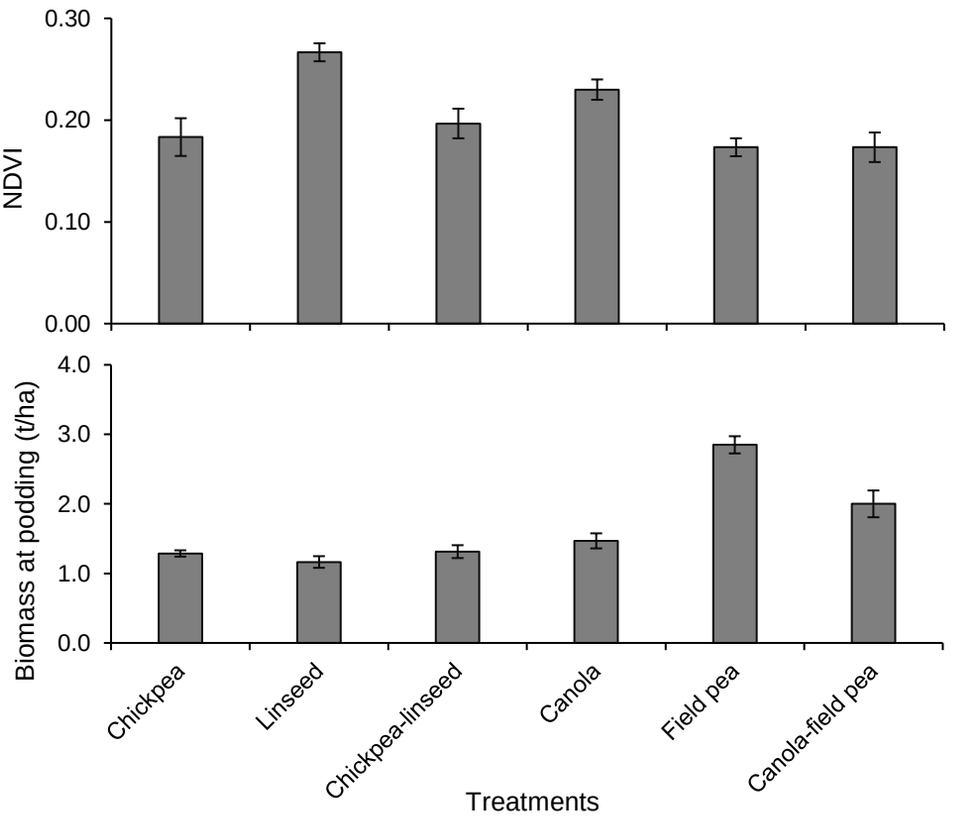

Figure. 1 NDVI (top) and biomass accumulation (bottom) of monocrop and intercrops at pre-flowering and at podding stage, Hart, 2019. Error bars indicate the standard error of the average NDVI or biomass.

Grain yield and LER

Grain yields across all monocrop treatments were below average for Hart in 2019. The field peas were the highest yielding crop at 1.06 t/ha (Figure 2). This was followed by chickpea, linseed and canola which had similar yields. In this trial the LER for chickpea-linseed intercrop was less than 1, which indicates grain yield was reduced when grown together compared to the monocrop yields (Figure 2). For peaola the LER was close to 1 suggesting the intercrop of field pea-canola maintained productivity relative to these crops sown on their own.

In 2020 wheat grain yields were similar for all previous crop treatments. Intercropping treatments did not increase or decrease wheat grain yield relative to the individual crops (Figure 3).

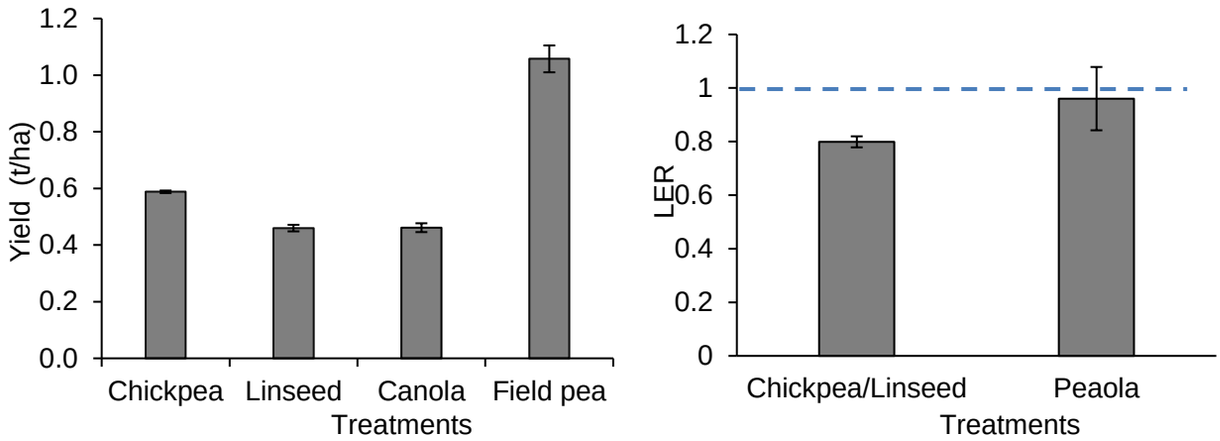

Figure 2. Grain yield of chickpea, linseed, canola, field pea monocrop (left) and LER (right) of intercrops at maturity Hart, 2019. The dashed blue line displays an LER value of 1.0, indicating no difference in yield between the intercrop and the collection of monocultures.

Intercrop performance in 2020

This season a small intercropping trial was repeated at Hart to assess the mono and intercrop combinations. The LER was similar to 2019 for peaola at 0.96. The chickpea-linseed LER was higher this season at 1.0. However, none of the intercropping treatments at Hart in 2019 or 2020 increased LER >1. This suggests there no yield advantage obtained by growing two species as an intercrop, compared to growing the same crops as monocultures.

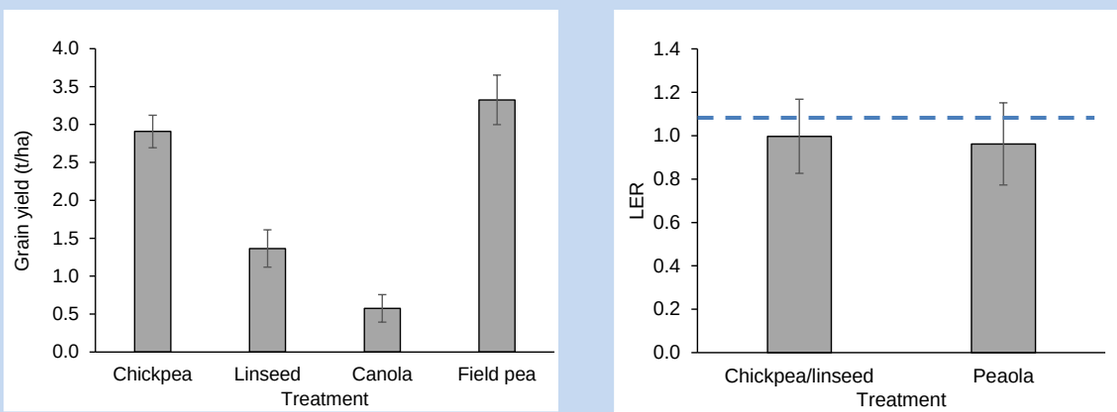

Photo: Intercropping trial at Hart in 2020; canola (Stingray) + field pea (Wharton) on September 9.

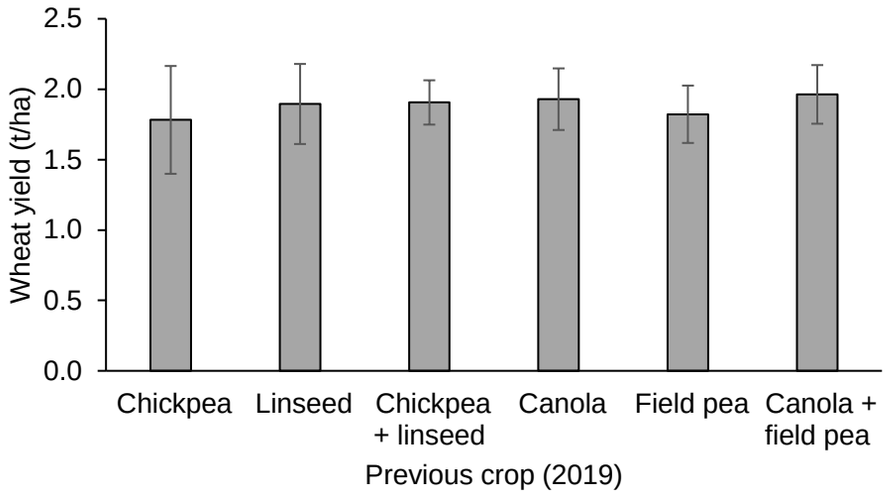

Figure 3. Grain yield for wheat sown over previous mono and intercrop treatments at Hart, 2020 (P≤0.05 LSD = NS).

Soil water dynamics

Total profile soil water is presented in Figure 4 and 5 for all treatments (except linseed monocrop) in both seasons. There was little difference in soil water use across all crop types. In 2019 the two intercrop treatments started to draw down more soil water in early August (Figure 4). However, once the profile become full again the draw down was similar for all treatments from mid-August through to harvest. This was unexpected due to the differences in soil moisture use / root architecture for the crops selected. Well below average rainfall at Hart in 2019 (162 mm compared to long-term average 400 mm) meant any rainfall or soil moisture received was quickly used by the crop. In an average to above average rainfall season there may be potential to see differences in total soil water use under the various crop types.

Coming in to the 2020 season there was no difference in residual soil moisture (data not shown). The following wheat crop was able to access similar amounts of moisture (Figure 5) whether the previous treatment was a mono or intercrop.

Photo: Intercropping trial at Hart, 2020.

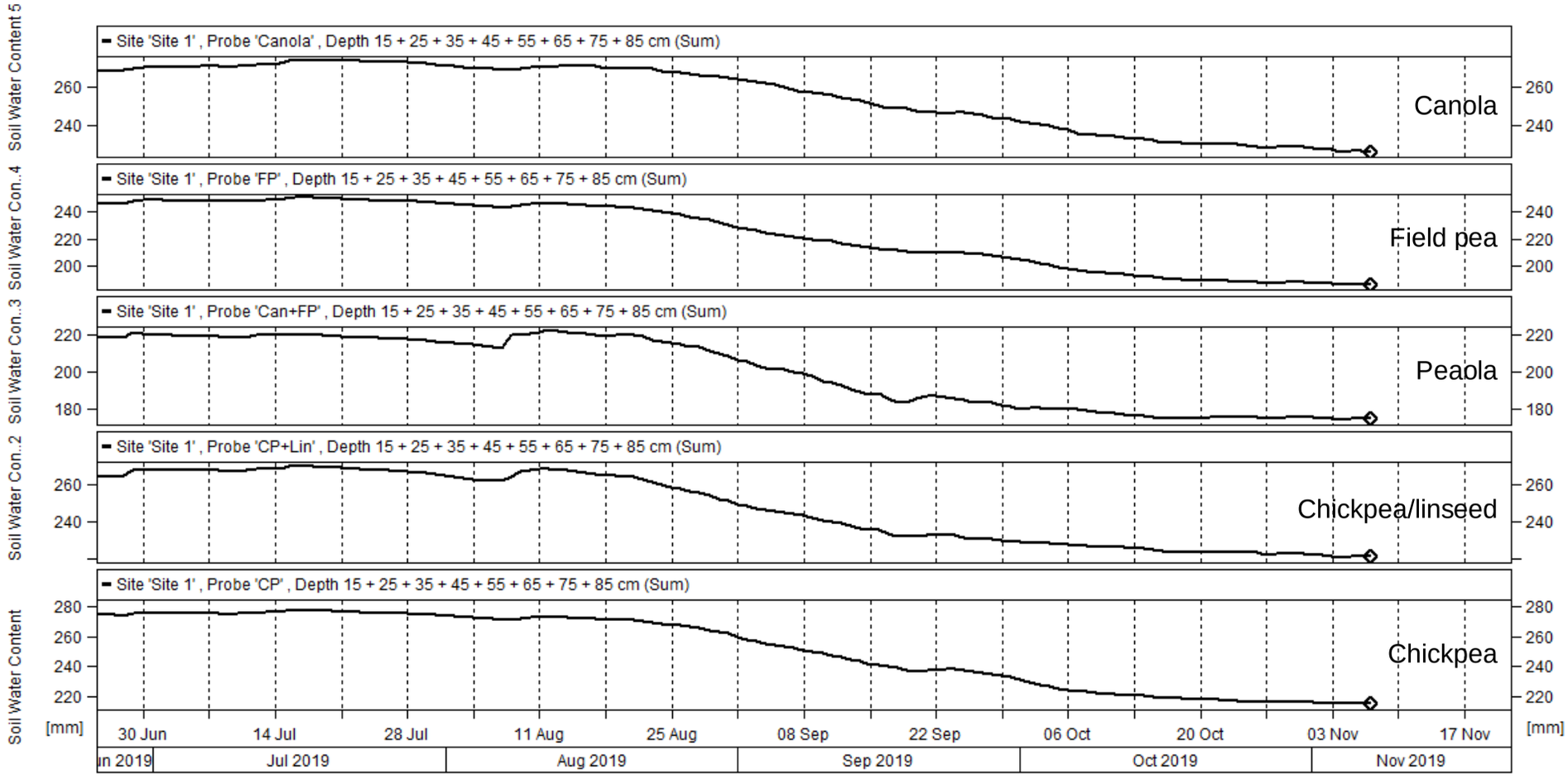

Figure 4. Soil water content measured by capacitance probes (EnviroPro 80 cm EP100GL-08) presented as the average for canola, field pea, peaola, chickpea and chickpea-linseed treatments at Hart, 2019.

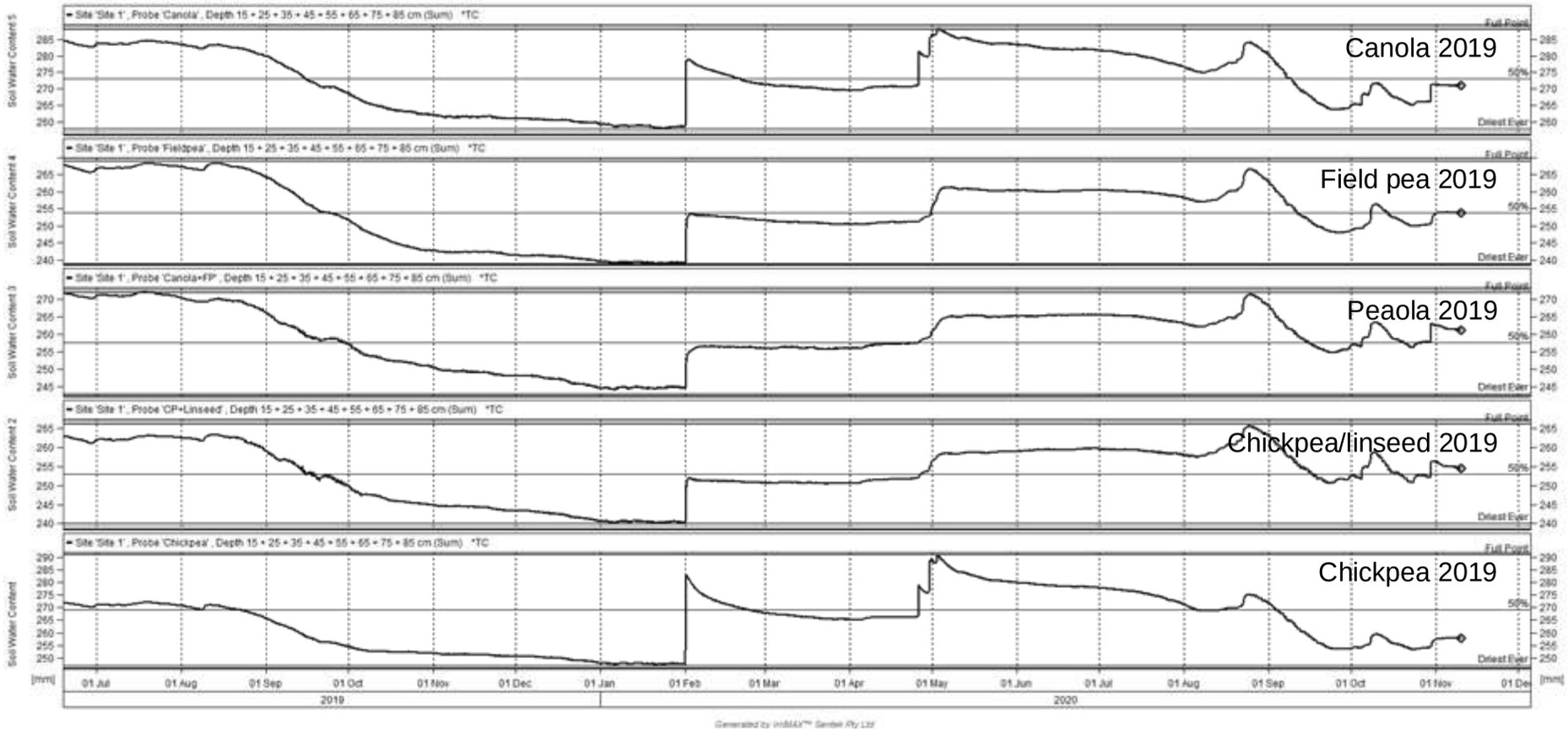

Figure 5. Soil water content measured by capacitance probes (EnviroPro 80 cm EP100GL-08) under Scepter wheat sown across the previous intercrops at Hart, 2020.

Acknowledgements

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References

Fletcher A, Kirkegaard J, Peoples M, Robertson M, Whish J, Swan A (2016) Prospects to utilise intercrops and crop variety mixtures in mechanised, rain-fed, temperate cropping systems. Crop & Pasture Science, 67, 1252-1267

Canola

Chickpea + linseed

Chickpea

Field peas

Linseed

Peaola

Photos: Hart intercropping trial on August 6, 2020.