Summer cropping after waterlogging

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KEY MESSAGES

- A small plot trial was established to assess the viability of late spring sown grain crops and compare to summer crops to determine the best economic outcome after severe winter waterlogging.
- The summer crops had excellent establishment across all locations and were successfully grazed three times throughout the summer period.
- Adequate biomass was produced at each site despite the relatively dry summer.
- Late summer rains allowed for continued biomass production after a dormancy period and subsequent grazes before termination of the multi-species trials.
- All sites were deemed to be profitable by the grower hosts.

Introduction

This GRDC invested trial is looking at the viability and profitability of summer cropping in response to waterlogged seasonal conditions. The trial was set up in response to the severe waterlogging experienced in 2021. The wet conditions caused widespread yield penalties in winter crops, degraded grain quality, poor germination, seed burst and often the inability to traffic paddocks to either seed or re-seed failed crops. Most areas within the Great Southern region of WA were adversely affected by severe water logging in 2021. Silo data shows that most of the region received a decile 8-10 rainfall year, with the key seeding months of April-June receiving well above the 51-year average rainfall. All of the growing season rainfall came after above average rainfall for the summer of 2019-2020. In 2021 we saw widespread early season crop loss or the inability to seed crops due to trafficability problems.

In the Great Southern region summer crops have predominantly been grown opportunistically when there is ample soil moisture post-harvest with the express purpose of filling the summer and autumn feed gap. Recently, some growers have started using summer crops to dry out waterlogged paddocks over the summer fallow period to prevent early season waterlogging in the following winter crop. This trial will examine if there is an opportunity to utilise summer crops to both mitigate losses from waterlogging, and whether there is a scope for a widespread integration of summer cropping into farming systems within the Albany Port Zone.

Results and discussion

Multi-species trial

The multispecies trial was sown into a saturated soil profile, on the 26th of October. Three large scale plots of 10ha, summer cropping varieties (sorghum, millet, and millet/lab lab mix) and a bare fallow (3ha) were established to assess the performance, viability, and legacy impacts of each summer crop. Soil tests and soil cores were taken from each plot prior to seeding, to examine how each summer crop effects soil water availability and soil nutrients for the following winter crop.

Grazing

The multi-species site was grazed a total of three times throughout the 2021/2 summer period.

The host of the summer cropping multi-species trial bases his economic decision-making process around one full graze being needed to make the crop financially viable. At the time of the first grazing the sorghum had produced 3.81t/ha of dry matter, the millet had produced 2.41 t/ha and the millet/lab lab mix had produced 2.59 t/ha.

Each treatment plot had a feed test analysis conducted on it to determine the nutritional benefits of each crop type. The millet and the millet/lab lab mix provided ewes with the highest metabolised energy per kg/DM. This coupled with the higher digestibility led to preferential grazing of the millet and lab lab, while the sorghum was left until last. As a result of this the millet and mixed species plots were over grazed during the first grazing event and struggled to regenerate biomass for the remainder of the trial period. Given the dry summer conditions, the species remained dormant for a long time before the late summer rains restarted the growth cycle, and the plots were able to be grazed two more times. Anecdotally each fodder treatment was successful in achieving the economic breakeven based on the grower hosts experience. However, the sorghum proved to be much more resilient producing a greater level of biomass at the time of termination.

Table 1: Nutritive value of each of the summer crops grown at Green Range in 2021/22.

NV Analysis	Millet	Millet/Lab Lab	Sorghum
Dry Matter (DM)	39.8%	19%	28.5%
Moisture	60.2%	81%	71.2%
Crude Protein	5.7% of DM	6.7% of DM	8.4% of DM
Acid Detergent Fiber	36.6 % of DM	40.2% of DM	36.1 % of DM
Neutral Detergent Fiber	68.7 % of DM	67% of DM	64.3% of DM
Digestibility (DMD)	65.7 % of DM	64.9 % of DM	59.1% of DM
Digestibility (DOMD)	62.5 % of DM	61.8% of DM	56.9% of DM
Est. Metabolisable Energy	9.7 MJ/kg DM	9.6 MJ/kg DM	8.5 MJ/kg DM
Fat	2.5 % of DM	2.5% of DM	2.6% of DM
Ash	6 % of DM	10.6% of DM	7.7% of DM

Table 2: Biomass (t/ha) produced from the three treatments in the multi-species summer cropping farm-scale demonstration at Green Range in 2021/22.

Treatment	*Biomass at First Graze (t/ha)*	*Terminal Biomass (t/ha)*
Millet	*2.41*	*0.71*
Millet/Lab Lab	*2.59*	*0.56*
Sorghum	*3.81*	*2.48*

The lab lab was very slow germinating and produced very little biomass until the end of the fallow period. This was likely due to the higher soil temperature requirements and the preference for warm and humid conditions to optimise growth. As a result, the roots failed to nodulate well enough to fix nitrogen, so it is likely that all three summer crops will result in a N deficit at the time of seeding the winter crop.

Figure 1: Millet/lab lab mix (left) sorgum (right) at the time of termination.

All the summer cropping treatments were effective in reducing the weed burden when compared to the bare fallow. Each treatment produced enough early biomass to out compete summer weeds in the early growth stages and the maintained biomass coupled with the grazing pressure supressed the weed burden throughout the fallow period.

Soil Moisture

At the end of the fallow period (29/04/2022) each of the summer cropping treatment preserved more water then the bare fallow treatment (figure 2). This can be seen as a somewhat paradoxical result, whereby growing a crop can preserve more water than chemically controlling weeds in a bare fallow. However studies conducted in nothern Australia have found that cover crops routinely result in more plant availble water than a bare fallow when the right variety of cover crop has been selected. As a rule of thumb, brassicas will use the most soil water, followed by legumes then grass crops.

A bare fallow's water retention is dictated by environmental factors and weed control. Typically, early termination of grass variety cover crops results in the greatest soil water conservation, as they provide ground cover, which prevents evaporation before developing a full canopy that will consume a large amount of soil moisture. This effect

Table 3: The volumetric water content percentage differential (the percentage of water, equalised to the volume of soil) for each summer cropping treatment at depths of 0-10cm, and 10-30cm, compared to the bare fallow at termination.

Treatment	*Depth*	*VSM% differential*
Millet	*0-10cm*	*+11.91*
Millet	*10-30cm*	*+1.69*
Mil/Lab	*0-10cm*	*+3.02*
Mil/Lab	*10-30cm*	*+1.77*
Fallow	*0-10cm*	*-*
Fallow	*10-30cm*	*-*
Sorghum	*0-10cm*	*+8.19*
Sorghum	*10-30cm*	*+8.80*

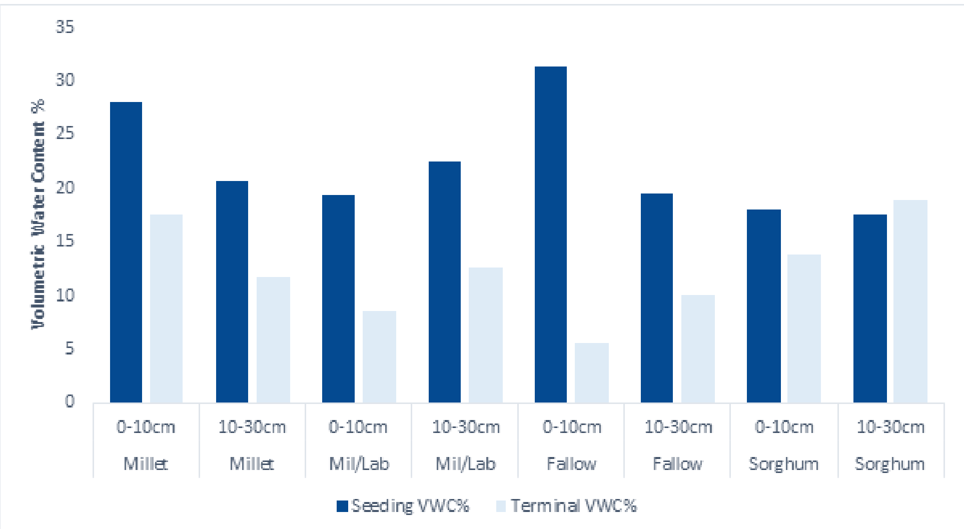


Figure 2: Soil volumetric water percentage for each treatment plot at the start and the end of the sumemr cropping phase.

has likely been amplified in this trial, where the grazing essentially resets the plant's traspiration requirements by removing the large leaf area, while a level of soil cover remains in place, in comparison to the bare fallow, which remains exposed to evaporation and the tranpiration requirments of any less palatable weeds. Additionally, summer cropping can improve water infiltration by increasing soil porosity and aggregation essentially increasing the field capacity of the soil compared to the bare fallow.

In this trial we found that the soil moisture in all three of the summer cropping treatments had a higher gravametric water content at the surface (0-10cm) and the sub surface (10-30cm) than the fallow treatment when factoring in the spatial variability observed in the baseline soil moisture testing at the time of seeding the summer crop (Table 3 and Figure 2).

It should be noted that the host farmer was aiming to utilise the summer crops to alleviate waterlogging pressure and dry out the soil profile leading into the 2022 winter cropping period. Given the high water use efficiency of the grass crops particularly in the early growth stages, the summer cropping plots failed to reduce the soil moisture content compared to the fallow. A brassica or legume species of summer crop would be more effective in reducing soil water content as a preventative strategy for waterlogging. However, these varieties likely would have suffered during the prolonged dry period throughout the summer.

Single Species Demonstration site

The single species demonstration was set up to examine the viability of winter type canola to fill the summer feed gap and be carried to full maturity the following season. The single species trial site was seeded with Hyola 970CL on the 29/10/2021, with the idea of grazing the crop throughout the summer and into the following autumn/winter, before removing the livestock before the crop's vernalisation trigger period (usually late July early August).

Table 4: Nutritive value the Hyola 970CL summer crops grown at South Stirlings in 2021/22.

NV Analysis	Winter Canola
Dry Matter (DM)	10.4%
Moisture	89.6%
Crude Protein	26.4% of DM
Acid Detergent Fiber	21.2% of DM
Neutral Detergent Fiber	28.5% of DM
Digestibility (DMD)	81.2% of DM
Digestibility (DOMD)	75.5% of DM
Est. Metabolisable Energy	12.3MJ/kg DM
Fat	4.4% of DM
Ash	10.5% of DM

The crop was sown into a saturated soil profile resulting from the wet winter/spring and established an average of 61.4 plants per m2, this figure is on the high end of the recommended target density of 40-60 plants per m2, however plants will be lost through the grazing period, so this should not adversely affect grain producing.

Figure 3: Grazed canola has"crisped off" during the dormant summer phase at South Stirlings (8 March 2022).

Figure 4: Canola during the regrowth phase after early the autumn break at South Stirlings (13 April 2022).

A feed test was conducted on the Winter Canola (970 CL) prior to grazing, to assess the digestibility and nutritional value.

The crop so far has been grazed twice, the initial grazing period lasted from the 27th of November until the 5th of January. Ewes were rotated on the crop, and were able to maintain their condition throughout this period, with the nutrition value of the canola easily meeting their nutritional requirements.

The crop then went into a prolonged dormant period from the 16th of Jan until the 10th of April. The grazing of the canola reduced its soil water requirements, by reducing the leaf surface area, this coupled with the plant's deep roots, allowed the crop to survive the prolonged summer period without rain and subsequently recover.

The winter canola's ability to recover from prolonged dry periods makes these varieties a particularly good option to mitigate waterlogging. The crop can be seeded into paddocks where the primary crop has failed, and grower can be confident that it can survive into the following season if managed well given it's tolerance for tough summer conditions.

The single species demonstration will be continually monitored over the 2022 season, after which the complete grazing and yield data will be analysed to establish the combined economics and profitability of the winter-canola.

Small plot trial

The small plot trial managed by Nutrien carried eight of the 11 varieties sown through to grain fill. The plots were seeded on the 15/10/2022. The cereals produced the best results, with the wheat yielding 2.14t/ha and the barley yielding 2.32t/ha. The ryecorn yielded 1.56t/ha, which represents a typical to good yield, when grown under ideal conditions. Ryecorn, when grown in Victoria, typically yields from 0.4 to 1.8t/ha. This result proves the viability of cereal rye to be produced as a summer crop in southern WA when soil moisture is available or as an alternative when crops have failed due to winter waterlogging. Given the high water use efficiency, heat tolerance and quick maturity, cereal rye sown into a saturated soil profile has a high yield potential, irrespective of the environmental conditions following sowing.

The wheat and barley yielded quite well given the lack of late spring and early summer rainfall. This highlights the ability for short-season spring varieties to produce adequate biomass in rapid time and become an economically viable grain crop. However, the mild summer conditions undoubtedly contributed to these yields, as it was unlikely the plants suffered severe heat stress during the critical post flowering, pre-grain set period.

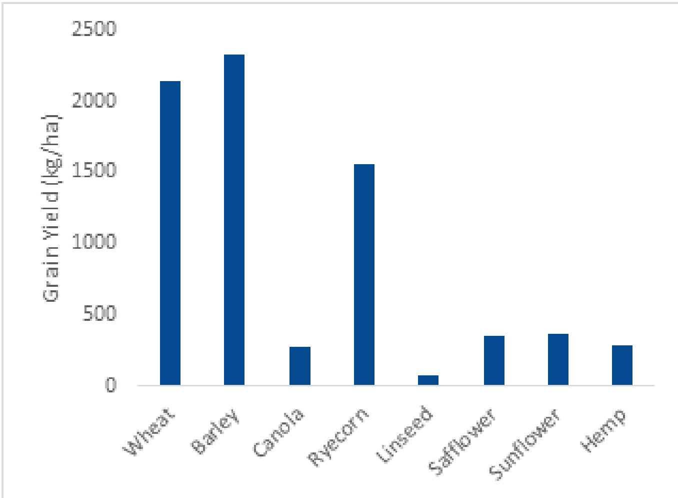
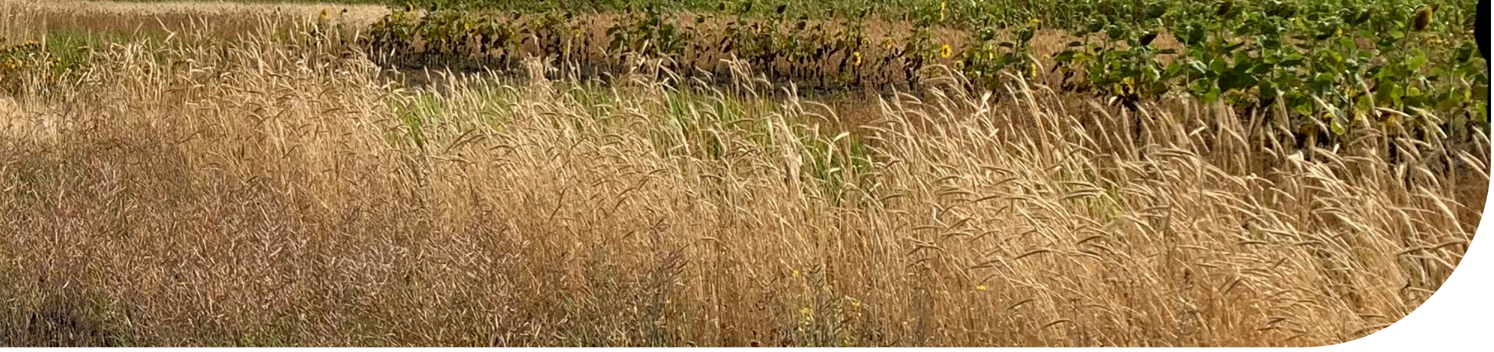


Figure 5: Grain yields (t/ha) from the Nutrien Small plot trial located at Green Range in 2021/22.

The canola, safflower, hemp, linseed, and sunflower failed to produce yields above 0.5t/ha. However, given the commodity price for some of these niche crop types and the low 2021/22 summer rainfall, it is likely that some of these crops could be economically viable. For example, hemp seed is currently worth $3000 t on farm, making a low-yielding crop economically viable in the Great Southern region.

Figure 6: Nutrien small plot trial at Green Range



The lucerne, millet, cowpea and lab lab failed to reach maturation; this was partly driven by the soil temperature requirements (+16 degrees) that drive germination being too high for the south coast. These crops could be a viable alternative off the costal fringe, especially given the lab lab and cowpea tolerance to heat stress and suitability to sandy soils.

General Discussion

This trial has demonstrated the viability for summer crops to be incorporated into profitable farming systems within the Albany region, and to be utilised to mitigate losses from waterlogging. The fact that viable summer crops were produced with the available soil moisture, without any additional rainfall or irrigation in the early growth stages should provide farmers with a greater degree of confidence when planting summer crops into a saturated soil profile. However, the impact of the summer cropping treatments on the 2022 winter crop and the overall summer-winter crop combined economics will provide a clearer perspective on how viable summer cropping is in Albany Zone.