Understanding return on investment of sub-surface water management options for waterlogged areas in the Western Region (Albany Port Zone)

Hosts: Preston Family (West Cranbrook) and Allison Family (Perillup).

By: Philip Honey, Smart Farms Co-ordiantor, SCF

KEY MESSAGES:

- **Yield gains from implementing sub-surface drainage at the Cranbrook Sub Surface Drainage Demonstration site equated to a net 1.23 – 1.28 t/ha yield increase in 45Y28 canola in 2022.**
- **Yield gains from implementing sub-surface drainage at the Perillup Sub Surface Drainage Demonstration site equated to a net 1.46 t/ha yield increase in 45Y95 CL canola in 2022.**
- **Sub-surface drainage is a waterlogging management solution that requires substantial upfront investment from growers, with fully "installed" costs typically estimated around $13,500 - $15,000/km.**

Background

Waterlogging is a common problem within the southwest region of Western Australia, particularly in the wetter months of winter, and typically occurs when rainfall exceeds the ability for soils to drain away soil moisture. Under these conditions, the excess water within the root zone creates anaerobic conditions (conditions without free oxygen) and prevents the plant from performing gaseous exchange with the atmosphere or biological activities with the oxygen in the soil, air & water. Left unmanaged, waterlogging can lead to soil structural decline and has the potential to create nutrient deficiencies & toxicities (such as Iron & Manganese toxicity), cause root death/reduced plant growth, or worst case, result in death of the plant.

Methodology/Treatments

Two subsurface demonstration sites have been established in the Albany Port Zone, with demonstration sites established West of Cranbrook (2021) and at Perillup (2022). At each demonstration site, Drainage Downunder installed 100mm slotted pipe at depth in the pre-selected trial area. The process involves running a mechanical chain-saw-styled trencher through the ground sub-surface to leave a trench, inserting the slotted pipe into the ground, and then in-filling above the pipe with Limestone caprock to allow water permeability. The drainage was designed with GPS elevation data, to ensure that there was sufficient fall in the pipe to allow the water to flow freely without impediment. Each trial site comprises of sub-surface drainage (slotted pipe) installed at depth across a minimum of 2 hectares. A control region prone to waterlogging (no-pipe installed) and a non-waterlogging site located upslope are utilised within the same paddock, to enable the ability to do a comparative yield analysis.

Results and Discussion

West Cranbrook Site:

2022 was the second year of field measurements for the Cranbrook demonstration site, with seasonal conditions finishing above average rainfall. Annual rainfall equated to 569mm for the year, with a growing season rainfall recorded of 454mm. Overall, the 2022 growing season rainfall levels led to waterlogging conditions being experienced in the control section of the drainage trial.

Drone imagery captured on the 5th of October 2022 visually captured a significant reduction in healthy biomass in the control region, and relatively healthy biomass levels were visible where drainage had been installed (red lines) as shown in Figure 1. At the ground level, water pooled at

Figure 1: Drone imagery capturing waterlogging conditions experienced on 5th October 2022, and a visible reduction in plant health evidenced in the control region, to the left of the drainage lines.

the surface in the control plot, and the canola plants had significantly lodged.

In mid-December 2022, the paddock was harvested by the Preston family. Overall, Canola yields were approximately 1.25 t/ha higher in the drained regions (2.97 – 3.02 tonnes/ha) compared to the control treatment (1.74t/ha). Two additional areas were also assessed at harvest where there was no drainage installed and where it was deemed unlikely to suffer from waterlogging. These areas across medium and high-performing soil landscapes represent what the maximum potential yield might be, should an area not express the yield penalty effects from waterlogging. When we compare the drained GRDC trial regions against non-waterlogging high-performing areas, then there is a potential yield opportunity of up to 1.17t/ha more yield potentially available. Unfortunately, the previously planned 'medium performing' soil didn't perform as well as the previous year, recording a yield value of 2.08 tonnes to the hectare, which was below the recorded yield values in the drained site (Figure 2).

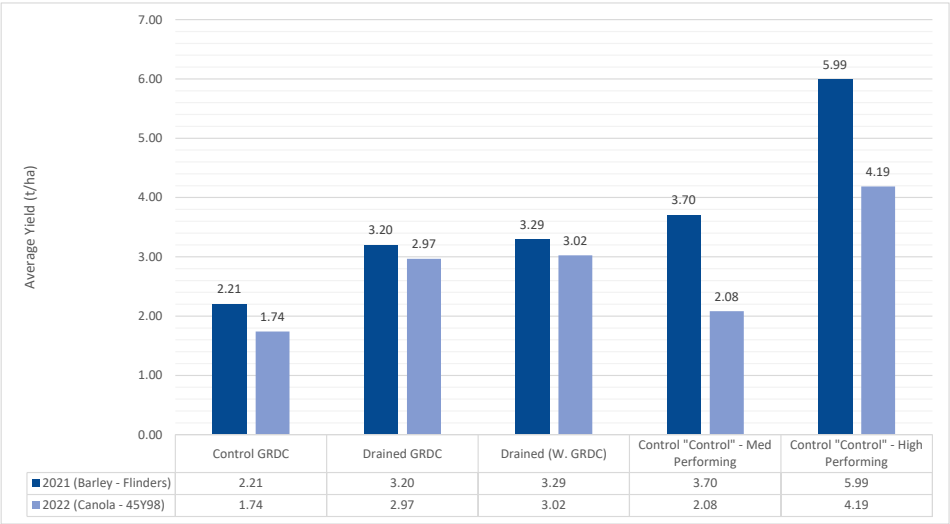

Figure 2: Final yields (t/Ha) obtained at the Preston Sub-Surface Drainage Site at Cranbrook in 2022.

Trials Site 2: Perillup

2022 was the first year of measurements for the recently installed demonstration site at Perillup, with rainfall values exceeding 709mm for the year, and 534mm for the growing season. Soil conditions for sowing were relatively dry despite the previous seasons' rainfall, and germination was patchy initially dependent on soil type within the paddock. Overall, rainfall typically tracked below the median 20-year average until late July, where the season turned around and tracked above median conditions. Given the cool conditions leading from spring into summer, the canola crop experienced optimal finishing conditions, with desiccation occurring in late November/early December, and harvesting beginning just prior to Christmas.

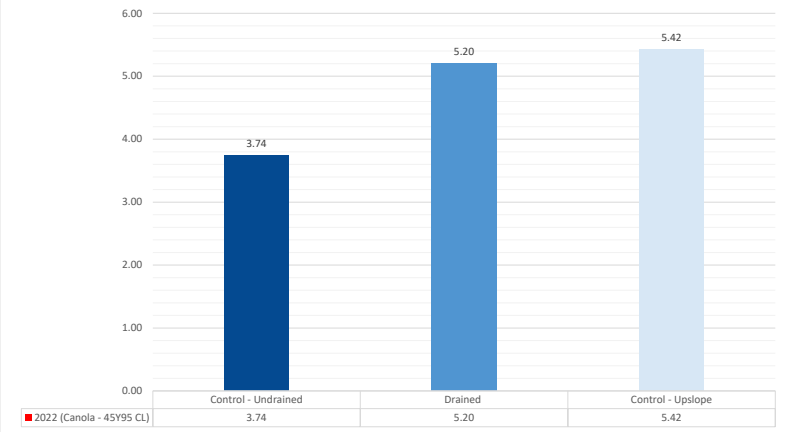

Figure 3: Final yields recorded at the Perillup Sub Surface Drainage Demonstration Site for the 2022 growing season.

The 45Y95 CL canola was harvested 20th December 2022 and yield data analysed for the drained region, undrained control and upslope (non-waterlogging) control within the paddock. Yield benefits for installed sub-surface drainage medium overall were positive, with 5.2t/ha yield recorded in the drained, and 3.74 tonne/ha recorded in the undrained control. The upslope control located nearby, within the same paddock yielded slightly higher than the drained, achieving a final average yield of 5.42 tonnes to the hectare.

Conclusion & Future Opportunities

The use of Sub Surface Drainage has once again shown a positive effect on final yields obtained for the 2022 growing season, despite a relatively dry start and a wet, cool finish. Yield differences were positive for the Preston site, expressing a 1.25 t/ha canola yield benefit, and a 1.46 t/ha canola yield benefit at the Allison family farm between drained and undrained regions of the paddock.

Taking into consideration previous yield increases from 2021 barley (47% yield increase) and combining it with the 2022 canola yield increase (72.5%) against the undrained treatments, the Cranbrook demonstration site shows significant positive potential yield benefits (circa 59%) from implementing sub-surface drainage across two above-median rainfall seasons. Initial, first-year yield increase responses at Perillup indicate that yield increases of circa 39% are possible.

As noted in the previous annual report, with installation costs in the order of approximately $13,500 - $15,000 per kilometre fully installed (purchase of pipe & limestone rubble, installation charges)*, getting the installation locations of pipework perfected will continue to be critical to ensure that the economic efficiency of subsurface drainage is maximised.

Prior back-of-envelope calculations for applying drainage to the remaining waterlogged regions of the West Cranbrook site estimated that there is a potential payback period of approximately 3.8 years to occur, pending a median barley grain sale price ($250/t) being achieved and similar yield differences as occurred in 2021 at the Cranbrook demonstration site. Utilising the same calculations comprising of a median canola price ($580/t) for 2022 and utilising the same neighbouring yield opportunity values, there could be an assumed $32,201 'lost yield opportunity' due to waterlogging, equating to a 1.52 years (canola) payback period on investment, with the same pricing/yield assumptions. Whilst installation comes at a cost, it certainly does raise some questions as to what the potential payback period might be for other areas within the region.

* Pricing is based upon a wide range of factors including area drained, drained soil types, availability of drainage pipe, freight and availability of limestone rubble, access to machinery and associated mobilisation/installation costs.

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