# Developing a Water-Jet System for Wide Row Grains.

*Greg Butler, R&D Manager SA No-Till Farmers Association* *May 2023*

Garry Ronnfeldt farms near Dalby, Queensland and he is an innovator that believes water-jet technology has a future as a sustainable farming tool.

'When I first saw the water-jet being used as a coulter, I believed it was going to be a useful tool for maximising residue retention to enhance our soils", Garry explained.

To further assess the application, the SA No-Till Farmers Association's demo water-jet unit was used on the farm at Dalby to cut residues with a variety of nozzles sizes and at different groundspeeds.

***Figure 1: A thick layer of residue that was cleanly sliced through by the water-jet tool (above) on the farm was inspected by a range of farmers and industry personnel (below).***

Australian Government | National Landcare Programme

*Supporting early-stage adoption of Ultra High-Pressure water-jet technology is a project delivered by the SA NoTill Farmers Association with funding support from the Australian Government's National Landcare Program.*

SANTFA CONSERVATION AGRICULTURE IN ACTION

Using the information generated by cutting the residue, the power requirements (Figure 2) and liquid rates (Figure 3) for three farm-scale water-jet configurations were modelled.

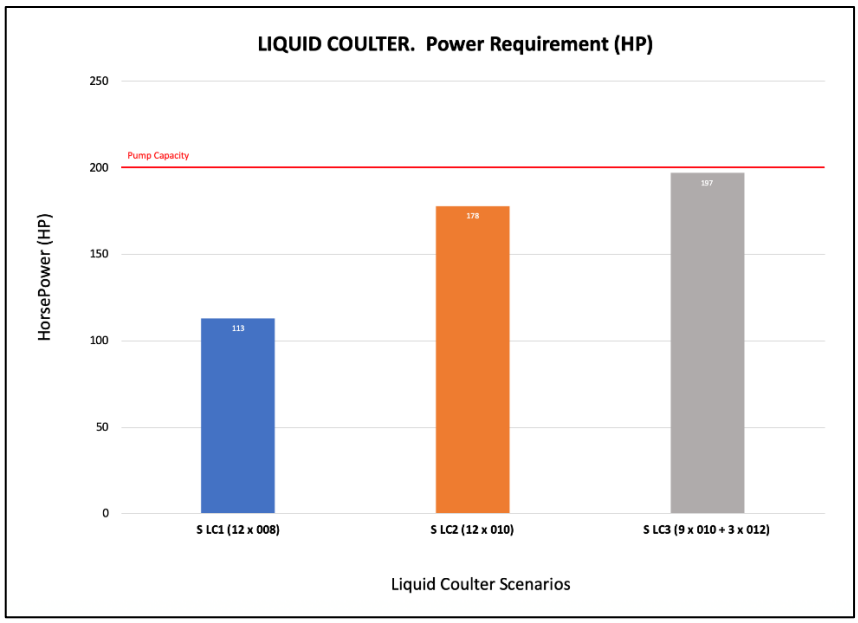


***Figure 2: Horsepower demand was estimated for 3 nozzle configurations on a 12-row seeder.***

The liquid rate (L/Ha) is a function of the row spacing, the orifice size and the ground speed.

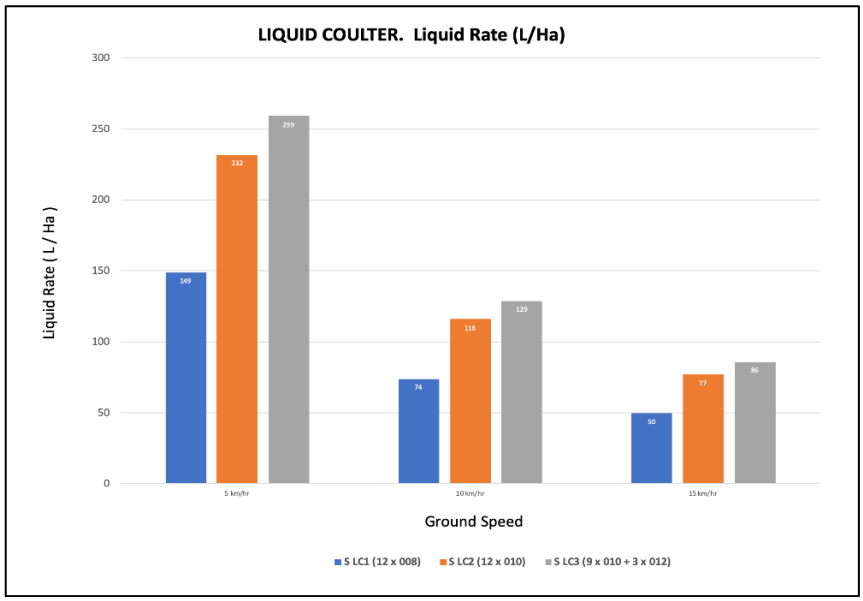


***Figure 3: Per hectare liquid rates for several scenarios were modelled based on ground speed, row spacing and orifice size.***

One of the most likely scenarios for the 12-row liquid coulter was a 0.254mm (0.010”) orifice on a 1m row spacing coupled with a ground speed of 10 km/hr.

This scenario was estimated to consume 116 L/ha when operating at 3,450 Bar (50,000psi), which was deemed to be acceptable; especially when compatible nitrogen fertiliser could make up a portion of that liquid volume.

Australian Government | National Landcare Programme

*Supporting early-stage adoption of Ultra High-Pressure water-jet technology is a project delivered by the SA NoTill Farmers Association with funding support from the Australian Government's National Landcare Program.*

SANTFA CONSERVATION AGRICULTURE IN ACTION

The water-jet system does have an operating expense and these costs were also estimated from the trial data (Figure 4).

The expense for diesel consumption is the main operational cost, and does vary depending on the nozzle configuration and ground speed.
It is worth noting that an ultra-high-pressure pump may also be powered from the tractor PTO.

Other water-jet expenses include orifice replacement and pump maintenance.
When using clean and filtered water, the orifices should last 1,000 hours.
Based on farm use rates of 200 – 300 hours per year, minor servicing is likely to be seasonal and major servicing bi-annual.

| Nozzle Configuration | Est. OPEX / Ha |
|---|---|
| 12 x 008 | $3.78 |
| 12 x 010 | $4.76 |

***Figure 4: Estimate OPEX at 50,000psi and 10 km/hr.****

Disclaimer: This information is an estimate only and is subject to change.
Included in OPEX:
+ Diesel consumption for stationary engine (Based on Cat C9 270HP and Diesel at $0.90 / L ex GST and after rebate) + Orifice replacement + Pump maintenance.
Excluded from OPEX:
- Cost of water. - Cost of UAN or herbicide. - Water filters. - Diesel engine maintenance, - Tractor, trailer or driver costs.

In 2019, the use of ultra-high-pressure water-jet for sustainable farming applications was still at the demonstration scale and the farm machinery supply chain had not yet engaged the concept in a meaningful way; which was understandable at the time.

Nevertheless, with the perceived benefits of the technology, Garry and his brother-in-law, Graham, an experienced diesel mechanic, began developing their own farm-scale water-jet system.

They started by converting a redundant cotton picker into a mobile water-jet, replacing the rear basket with a 50,000psi Flow Husky pump coupled with a 260HP diesel powerplant and a liquid tank. (Figure 6).

***Figure 6: The 50,000 psi Flow Husky and diesel engine was fastened onto the redundant cotton picker chassis***

The team pair also developed a front mounted hydraulic lift bar to carry the engagement tools on the front of the vehicle.

The role of the engagement tool is to securely hold the nozzle in a way that will ensure effective cutting of the residue as the unit traverses over the ground. (Figure 7)

***Figure 7: Graham working on the parallelogram inspired engagement tool. The basic design has been modified to accommodate the grains application (vertical nozzle) and an alternative application for cotton ratoon control (horizontal nozzle)***

Australian Government | National Landcare Programme

*Supporting early-stage adoption of Ultra High-Pressure water-jet technology is a project delivered by the SA NoTill Farmers Association with funding support from the Australian Government's National Landcare Program.*

SANTFA CONSERVATION AGRICULTURE IN ACTION

In addition to building an integrated water-jet system from scratch, the future operations, maintenance and servicing of the ultra-high-pressure water-jet machinery was also at the front of mind.

To contain the perceived risks and potential costs of adopting an ultra-high-pressure water-jet system without the support of a local farm machinery dealer, Garry and Graham's preference was to gain the skills required to maintain and service the equipment themselves.

To achieve that, the farm hosted a hands-on industry training event over several days; bringing an experienced water-jet technician from the US (Shape Technologies) to teach a group of interested farmers and industry personnel from across Australia. (Figure 8).

The comprehensive training broke down the component in the water-jet system and provided the team with the confidence that on-farm service and maintenance of water-jet machinery is achievable for farms with the will and complimentary skills.

***Figure 8: The training event covered a range of theoretical and practical aspects of water-jet safety, operation, service and maintenance.***

After a few hellish seasons including persistent drought followed by back-to-back flooding, the project is still moving forward. The latest iteration of the machine was demonstrated for the public in June 2023. (Figure 9 & Figure 10).

***Figure 9: The farm scale water jet system was demonstrated at Dalby in June 2023. The bar lowers to put the water-jet directly on the residue.***

Garry initially envisaged that he would couple the water-jet directly to the seeder, however, after a couple of years of experience, the technology is better suited as a pre-drilling machine, whereby, the upcoming plant rows are pre-cut and deposited with some starter fertiliser before the seeding window; when time demands are not so critical.

***Figure 10: Residue that was cleanly cut with the farm-built water-jet system at the Dalby field day in 2023.***

Garry explained, “We have a very tight timeframe for effective seeding and we want to be as efficient as possible during that window of opportunity”.

If the residue coving the soil is cleanly pre-cut along the GPS controlled seeding lines and deposited with a little starter fertiliser, it is hoped that should make the actual seeding operation more efficient.