GROWER SOLUTIONS FOR COASTAL/HINTERLAND QLD AND NSW NORTH COAST

2018 PRACTICE CHANGE CASE STUDY | *GRDC PROJECT CODE: DAQ00204*

Managing heavy clay soils to improve grain cropping in a high rainfall environment

HILLING or RAISED BEDS

The NSW North Coast can experience very heavy rainfall events during summer, often when grain crops are ready to be harvested.

The heavy clay soils of the area are classified as Mottled, Self-mulching, Black Vertosols or Black Earth. These soils crack when dry and swell when wet, affecting infiltration of rainfall into the root zone.

When water remains on the surface of the soil it can affect crop establishment and crop growth due to water logging resulting in reduced grain yield.

Growers require easy access to paddocks to sow, spray or harvest crops in a timely manner without causing damage to the soil or impacts to crop growth. They also require a bed configuration to suit the row spacing of their grain crops and to maintain adequate soil moisture for the growing crop.

To manage grain production on these soils, in a high rainfall environment, growers have needed to:

1. Reduce damage to soil caused by harvesting on wet soil
2. Reduce cultivations required to prepare a seed bed and
3. Control traffic to separate the compacted (wheel track) zones from crop growing (root) zones.

TWO APPROACHES

Fred Faulkner and Paul Fleming have made changes to their farming practices to manage their heavy clay soils.

HILLING

Fred Faulkner:

- used existing machinery to create permanent single row hills renovated after harvest
- reduces tillage and limits traffic in the crop growing zone
- adds organic matter via poultry manure; and
- retains stubble and utilises green manure crops

RAISED BEDS

Paul Fleming:

- laser levelled and implemented a well designed drainage plan to remove excess water
- created permanent raised beds (two or four rows on top of the beds) that accommodate a range of crops and machinery
- uses GPS guidance for controlled traffic
- maintains groundcover on the beds to keep soil covered

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Fred Faulkner's Farm

GROWER PROFILE

- Crops 242ha (600 acres) across two farms at Dobies Bight and Shannonbrook Northern NSW.
- Summer grain crops including a two-year soybean, two-year maize rotation.
- Soybean crop is often followed by a quick-growing winter crop for green manuring, usually faba bean, dependent on weather conditions at time of harvest.

IMPROVEMENTS TO THE FARMING SYSTEM – THE PRACTICE CHANGE

Several years ago, due to rising fuel costs and the difficulty in preparing a seedbed in his heavy clay soils, Fred converted his cropping system to permanent single row hills (single row on a raised hill) renovated after each harvest. This hilling practice also assists excess surface water to drain.

The three main reasons Fred adopted a hill system wer e to:

1. Improve traffic-ability and timeliness of harvest;
2. Confine compaction to the wheel tracks while leaving the growing zone undamaged; and
3. Better adapted row configuration required to grow cereals.

Fred initially experimented with hilling on approximately 50% of the farm however, after a few years the improvements he witnessed prompted him to use hills on all of his cropped paddocks.

BENEFITS

- Increased grain production, particularly on the heavier, harder to manage soils on the farm.
- An improvement in soil structure.
- Reduced input costs (fuel and time).
- A 50% reduction in the number of machinery passes needed to prepare the seedbed (from eight to four).
- Using existing machinery made it easier to change to a hill system.

THE OPERATION

Fred uses a permanent single row hill system rather than a raised bed with multiple rows, because it suits his existing machinery, which is set up on a 900mm (36 inch) row spacing.

Despite not having GPS guidance, Fred reduces the traffic in the root-growing zone by keeping traffic to the inter-row between the hills in his paddock.

Maize (corn) stubble on hills after harvest.

Hills after sowing maize.

- The hills are created using a furrower after every crop (*Excel guess row averager* model).
- A centre-bust (single row ripping) operation is carried out after each harvest to help break down stubble and reduce pest and disease risk.
- Short fallow.
- Winter weed control with an application of a pre-emergent herbicide on the hills after the crop has been sown. If needed a further shielded spray is used in the soybean crop.
- After harvest, the maize stubble is mulched and the centre-busting operation completed. Eight tonnes per hectare of poultry manure is applied.
- Finally, the hills are re-formed with the furrower, which helps to incorporate the stubble and poultry manure. Fertiliser for each crop is banded in the hill just before sowing.

MACHINERY

To implement the permanent single row hill system, the following machinery is required:

- Bed renovation – a furrower (Excel guess row model), a 4-row machine with a disc in front to split the bed, followed by furrowers that reshape the hills
- Sowing – a vacuum planter (Excel model)
- Machinery able to cut through maize (corn) trash is essential.

> *"Be prepared to try the system for two to three years before expecting to see results.*

FUTURE CHALLENGES

In the next two to five years Fred wants to improve drainage to remove excess surface water and to reduce the impact that he has on the soil during wet conditions, especially at harvest.

GROWER TIPS FOR HILLING

- Try to devise a system that fits with your existing machinery.
- If growing maize (corn) it's very important to get machinery that can handle a large stubble load.
- Be prepared to try the system for two to three years before expecting to see results.
- Design the layout so it will shed excess water effectively. If water builds up or moves too quickly across the ground surface erosion can remove top soil.

DOES IT PAY?

This is a measure of the financial, social and environmental benefits as a result of changing the farming practice.

FINANCIAL

Reduced costs and improved yields mean that changing the farming systems effectively has no trade-offs.

Gross margin

The impact of high rainfall and poor drainage can significantly impact on grain yield. The level of this impact varies with the season.

Factoring in a conservative 10% yield improvement and a price per tonne of $550 for soybean, results in a 23% improvement in the soybean crop gross margin.

For the maize crop, an increase in yield of 10% and a price of $300/t would provide a 22% improvement in gross margin.

Crop	Price $/t	Old system yield t/ha	10% yield increase t/ha	% increase Gross Margin
Soybean	550	2.5	2.75	23%
Maize	300	7.5	8.25	22%

*** Yield of 10% used but yields greater than this have been achieved with the new system.**

MACHINERY COSTS

Over the four- year cycle Fred reduced his machinery operating costs by 54%.

SOCIAL

The new system has seen a 45% reduction in time spent on tractor operations. This has the potential to reduce stress and allow other farming operations to be carried in a more timely manner.

ENVIRONMENTAL

The environment has benefited from reduced fuel usage.

Paul Fleming's Farm

GROWER PROFILE

- Crops 273 ha (675 acres) in the Casino area, Northern NSW.
- Rain-fed (dryland) soybean and maize (corn).
- Winter cereals include triticale and barley (season dependent).
- Sugarcane in rotation with soybean on low country.

IMPROVEMENTS TO THE FARMING SYSTEM – THE PRACTICE CHANGE

Paul's property has a long history of cropping and conventional cultivation based on tillage operations, such as deep-ripping, discing and scarifying. These operations were carried out after harvest of the soybean crop harvest to get soil 'back into shape'.

Paul is very focused on looking after his cropping soil and over the past few years has made several significant changes to his farming system and farming practices including:

1. Laser levelling the property with wide and open tail drains constructed to remove the excess water away from the crop zones. This was to achieve improved drainage which is especially important in the critical phase of crop germination and establishment as waterlogged soil reduces emergence and results in low and uneven plant population.
2. Forming raised beds with furrows at 1.8m to improve drainage of the heavy clay soil and to improve the root zone for grain crops (improve infiltration of moisture and reduce compaction). The beds enable a range of crops to be sown with fewer cultivations to prepare the seed bed.
3. Using controlled traffic with permanent wheel tracks that will harden over time and improve traffic-ability in wet conditions, whilst protecting the plant growing zone from compaction.

BENEFITS

- No decrease in crop productivity
- Reduced tillage and a 44% reduction in machinery operating costs
- An improvement in soil friability, structure and moisture retention especially on shallow soils and any lighter country
- Increased gross margin by lowering machinery operating costs and yield improvement
- Half the number (four) of machinery passes needed to prepare the seedbed
- Reduced time input and the ability to carry out operations in a more timely manner
- Bed system allows greater versatility to grow a variety of crops (soybean, maize, winter cereals, and sugar cane), without altering bed formation
- Maintaining groundcover on the beds (with crops) minimises erosion damage and improves water infiltration

A raised bed system prevents soil damage like this.

THE OPERATION

Paul uses a raised bed accommodating two rows of soybean at 800 mm row spacing, which allows the use of a shielded sprayer for weed control. Four rows of winter cereal are sown on the beds at 300 mm row spacings, which are offset from the soybean rows.

Compaction damage is confined to tracks and soil for growing crops is protected in the beds.

Tail drains with good groundcover prevent erosion.

> *If you don't have to fix the damage from harvesting a wet boggy paddock, you can get another (winter) crop in.*

For the second year of soybean after a winter cereal crop, Paul moves the planter units on his disc planter (Kinze model) by 50mm so that they are not in line with the recently harvested cereal stubble.

In summary, Paul's crop sequence is as follows:

1. Harvest soybean crop
2. Fallow weed control
3. Direct drill winter cereal or leave fallow until summer sowing.
4. Following a corn rotation, the corn stubble is mulched behind the header and beds are renovated soon after using one pass of a disced bed renovator ('Go Devil' model).
5. The beds are then left for a couple of months. A light cultivation and rolling is completed prior to sowing (modified Lilliston model).
6. Sow next crop.
7. Shielded spray for in-crop weed control.
8. Integrated pest management strategies are applied.

Planting, cultivation and all other in-crop operations are now carried out on the same wheel tracks. Paul believes he couldn't renovate without GPS guidance as it keeps the tractor in the wheel tracks even when previous tracks are not clearly visible.

Paul aims to renovate his beds every three years after the corn crop phase to help incorporate the heavy stubble. This renovation also helps to square the shoulder of the beds that can slump over time due to settling or erosion or soil and from wheel damage. Renovation facilitates easy harvesting of the soybean crop.

What machinery is needed?

To implement the raised beds (two or four rows on top of the beds) system, the following machinery is required:

- GPS assisted tractors are essential for the system to work.
- Modified machinery for renovating bed tops and incorporating stubble (a Go Devil disc renovator and set of Lilliston light cultivators).
- Planting - summer crops with a double disc opener 8 row planter (Kinze model) and his winter crops with an air-seeder (Rogro model) to sow four rows on a bed. This can be used as either a tyned or a disc opener planter to cope with high stubble loads.
- Controlled traffic with tractors on the farm with beds and wheel centres at 1.8m and the header with wheel centres at 3.6m.

FUTURE CHALLENGES

Paul hopes that in the future only a renovation of the bed edges will be required every two to three years. He would like to further refine the bed renovation and stubble incorporation processes to minimise soil disturbance and provide a good seed bed.

Paul is also concerned about hard-to-kill weeds in his new system and is considering mechanical options for weed control in the middle of the bed.

DOES IT PAY?

This is a measure of the financial, social and environmental benefits as a result of changing the farming practice.

FINANCIAL

Change Gross margin/ha

Crop	Price $/t	Old system yield t/ha	New System Yield t/ha	% increase Gross Margin
Soybean	550	2.5	2.75*	42%
Maize	300	7.5	8.25*	20%
Barley	220	2.5	3.00	6%

* Yield of 10% used but yields greater than this have been achieved with the new system

MACHINERY COSTS

Over a three year cycle (soybean, barley, soybean and maize) there was a 44% reduction in machinery costs. This contributes to the improved gross margins

SOCIAL

Time for a grower is the often the most limiting factor. Over a 3 year cycle, time spent driving tractors has decreased from 6.06 hrs/ha to 4.55 hrs/ha, a reduction of 24%.

Paul says "Freeing up time has allowed me to expand the size of my operation and put more attention to detail on crop agronomy issues. It also allowed me to build and modify my own equipment to suit my new farming system."

ENVIRONMENTAL

The environment has benefited from reduced fuel usage.

OTHER CONSIDERATIONS

To reduce the risk of erosion over large areas, consider adding drainage channels throughout the paddock. This assists in removing excess surface water. The use of drains, laser levelling and some banks with the natural slope and fall of the paddock to dispose of surface water is an important consideration.

Heavy stubble load after maize (corn) crop.

GROWER TIPS FOR RAISED BEDS

- Be committed for two to three years to see results. When changing from full conventional to reduced tillage, there is a transition period where persistence is needed for the benefits to emerge.
- Make sure you have the right machinery for what you want to do, spend time working out what best fits your needs. Maybe start off with one paddock and then modify a small piece of machinery. You may not need to purchase anything new to get started.
- Practice controlled traffic with GPS assisted machinery. You cannot rely on your own eye. You may be able to hire a contractor with GPS equipment to form beds, and then you have the furrows to follow until bed renovation is required.
- Use a controlled traffic approach and modified wheels on the harvester to manage wet harvests
- Try and keep your soil covered with either crops or stubble to reduce the crusting effect of rainfall on bare soil.
- Use machinery that can handle a large stubble load. This has been overcome by using trash sweeps on planters and a disc renovator (Go Devil model). This is followed by trash sweeps after the stubble has started to decompose.

MORE INFORMATION

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