A PRACTICAL 'SPADE AND SOW' APPROACH TO SANDY SOIL AMELIORATION

Landholders: Tim & Andrew Polkinghorne (and families)

Property: Kingara Farms located near Lock at Polda & Hambidge

Enterprise: Broadacre cropping

Average annual rainfall: 320 - 360 mm across properties

Landscape and soil description: Gently to moderately undulating dune-swale with duplex sandy rises and loamy flats

Area treated: 1,000 ha

KEY MESSAGES

- 'Spade and sow' enables opportunistic soil amelioration at any time where seasonal conditions are right and labour resources are available.
- Good planning minimises disruption to other farm operations and increases the chances of success.
- Sowing immediately after amelioration helps stabilise fragile sands, firm the soil surface and establish cover quickly, reducing erosion risk over time.
- The practice is best suited to targeted problem areas where soil constraints are well understood, and the likely production gains justify the extra operation.

Water repellent surface soils, which often lead to poor crop establishment and low surface cover, are one of the biggest production constraints on the Polkinghorne's sandy soils. In addition, the Polkinghorne's have also identified areas of high soil strength that limit crop root development and restrict access to stored soil moisture.

Over several years, landholders Andrew and Tim Polkinghorne have employed a range of soil modification techniques to address sandy soil constraints, including deep ripping and clay delving.

Most recently, they have adopted a 'spade and sow' approach to ameliorate multiple soil constraints in one pass, whilst reducing the length of time that freshly ameliorated soils are exposed to wind erosion risk.

DEFINING THE ISSUE

Previous work using a straight shanked ripper, fitted with inclusion plates, demonstrated that many soils across the Kingara Farms properties would respond positively to ripping. Areas where ripping has been targeted and optimised, particularly on soils where clay was brought up, Tim has observed yields double that of the unripped controls.

As Tim explains, extensive planning has been pivotal to the success of Kingara Farms' soil amelioration program.

"For each property, on a paddock-by-paddock basis, we assessed which areas would benefit from amelioration, and which treatment option would be most appropriate.

We target the weakest performing areas of the paddock first, with other production zones then worked through, stopping where rock is encountered."

TREATING THE ISSUE

Based on the crop response from his previous deep ripping treatments, Tim believes that if clay was uniformly located 300-600mm below the soil surface, a deep ripper with parabolic tynes will loosen layers of high soil strength and lift clay into the infertile layers, sufficiently addressing production constraints.

However, due to variable depth to clay, and varying soil types across his landscape, Tim needed to consider other amelioration options. This led him to source an Imants spader from Western Australia, complete with ripping tynes and custom fitted sowing kit.

The reason for selecting this unit, Tim says "we were impressed with the Imants spader as it provided us with an all-in-one option to address the constraint, incorporate and sow, which we felt would make ameliorating our sands more efficient".

Tim's Imants spader with deep ripping boots at front and fitted with seed box. [Source: Tim Polkinghorne]

"The sowing kit consists of an airseeder box designed to fit the spader. Sowing boots positioned between the spading rotor, and press wheels, allow seed to be dropped at a sowing depth of 10-15mm then pressed in," Tim explains.

Tim is confident that the Imants unit provides the opportunity to rip through high soil strength constraints, mix repellent surface soils, and sow to establish cover in a one pass operation.

"The only exception we have identified so far is where clay is too deep in the profile, and a delver is required," says Tim.

HOW WAS IT DONE?

Approximately 150 hectares were identified as being unsuitable for the spader, due to clay sitting too deep for it to be effective.

As a result, a delving contractor was engaged to bring up clay at depth, before then passing over with the spade and sow machine.

"By identifying areas of deeper sand during our planning process and having a large enough area to ensure it was financially worthwhile; we engaged a delving contractor where our machine would not be as effective in ameliorating the clay at depth," shares Tim.

He highlighted that if he was unable to secure a contractor for the delving, he wouldn't have had the labour units required to be able to delve and spade on same day, which he feels is an important step to getting good cover and good weed control.

Initially Tim used 'spade and sow' as an opportunistic tool explaining, "weed pressures in particular paddocks, and my impatience to tidy problem areas before they went into the cropping stage, previously played a big role in making the decision to 'spade and sow'."

Area of deeper sand being delved prior to spading and sowing. [Source: Tim Polkinghorne]

"For example, when summer rainfall paused harvest one year, we swung our harvest labour onto ameliorating a paddock that was due to be sown to lentils the following year."

Tim spaded and sowed a mixed species cover crop, using left-over cereal, lupin, canola and sunflower seed on hand.

POST AMELIORATION MANAGEMENT

'Spade and sow' in this situation enabled Tim to establish cover as soon as possible following amelioration, minimising erosion risk and leaving a level soil surface.

Summer mixed cover crop sown following rain at harvest. [Source: Tim Polkinghorne]

"Once the cover crop is established, we generally don't need to carry out any further operations on these areas until the cover crop is terminated and incorporated with a speed tiller prior to sowing", explains Tim.

Previously, the sandhill would have been covered in capeweed. Not only did this technique provide good weed control in the lentil crop, it also provided better trafficability and control over sowing depth, than Tim would normally see following soil amelioration.

WHAT HAVE BEEN THE CHALLENGES?

Despite getting good crop growth responses on all areas where he has undertaken single pass 'spade and sow', Tim highlights several practical considerations.

"At Kingara Farms, the tractor we used on the spader is the same one used for the second seeder, meaning we cannot undertake both operations at once," says Tim.

For this reason, when utilising 'spade and sow' to establish winter crops, Tim would prefer to undertake the operation either "at the start or at the end" of his seeding program.

Tim feels that whilst most people could effectively drive the tractor attached the deep ripper, it is important to have someone experienced and capable operating the spader. He mentioned that he has experimented with spading some areas of deeper calcareous sands, however has noticed that in patches where he didnt lift the rippers out of the ground crop establishment was poorer, even several years after the intial operation.

Trafficability after spading has also been an ongoing challenge for Tim.

“If we could get better compaction behind the spader and improve harvesting conditions, it will allow machinery to traffic easier across the paddocks sooner. The press wheels aren’t quite firming the soil surface enough on their own, so this is something we need to look at in future”, says Tim.

“At the moment, we can’t use the self-propelled sprayer on newly spaded areas, as it ‘floats’ too much and will not hold a straight line”.

To manage this, Tim uses another spray tractor fitted with dual tyres for the first couple of post amelioration applications, until tracks firm up.

However, this can increase the risk of wheel tracks becoming rutted.

EVOLUTION OF ‘SPADE AND SOW’

Whilst Tim is still employing the practice to establish mixed species cover crops during summer, in recent years there has been a shift from opportunistic use of ‘spade and sow’, to the practice being strategically incorportated as a more formal part of the seeding program.

Initially, Tim had concerns that the ‘spade and sow’ system would lock him into a herbicide cycle relying on imidazoline chemistry, with limited opportunity to use pre-emergents on freshly ameliorated ground (due to the risk of injury to newly establishing crops).

He has since overcome this challenge by using long season wheat varieties (specifically LPB Mowhawk[PBR]), which has allowed him to establish a crop, as early as March, utilising and retaining deep stored soil moisture brought up by the spader, and maintaining the ability to control weeds in crop with post-emergent grass selective herbicides.

WHAT IS THE BENEFIT FROM THE IMPOSED TREATMENTS?

Tim is overwhelmingly positive towards the response from his ‘spade and sow’ operations.

To date, he has not had any issues bringing up too much clay using this practice and says that “wherever enough clay is brought up and mixed to change the soil colour, there seems to be a positive crop growth response”.

In addition, Tim has observed improved crop establishment where the spader has been used through deep white sand, although he is less certain about the longevity of the response on these soils.

The business case for purchasing the spader suggested savings of $5,000 per year in labour, by combining ripping, spading and seeding. Tim considers the ‘spade and sow’ operations have enabled him to greater timeliness in sowing these areas.

“Freshly ameliorated ground can be sown without needing to wait for the additional levelling, incorporation and rolling that are normally associated with soil amelioration. This means these areas can be sown alongside the rest of the paddock, allowing establishment to occur at the same time, using the same seed, seeding rate and fertiliser program”, shares Tim.

Tim sees this as one of the biggest benefits as a more reliable germination and even crop establishment, particularly where stored soil moisture can be accessed.

A second major benefit has been improved weed control, although Tim is not sure if this results from improved chemical efficacy, even germination in weeds, reduced crop competition, or a combination of these factors. He has noticed particular benefits with weeds like capeweed and brome grass.

Tim has also undertaken some of this work early, the last week of March, sowing long season wheat varieties. This allows him to minimise the risk of frost damage at critical grain development, whilst providing enough soil moisture to sow into and be confident of good crop establishment.

Given that the business already had access to the tractor used by the spading operations, the business case indicated a 4-year payback period using conservative estimates of yield gains.

However, Tim observes that yield gains have been higher than expected with a payback period likely to be much quicker than this.

WHAT DOES THE FUTURE HOLD?

Tim is interested in refining the use of summer cover crops within the 'spade and sow' system. While he recognises that establishing cover crops comes at a cost in seed, fertiliser and fuel, his view is that "roots grow roots", and that maintaining cover on these areas is likely to be more beneficial than bare ground.

While Tim is conscious that having living cover over summer might result in a soil water deficit for the following years' crop, he says that he has only implemented this after significant summer rainfall events and hasn't seen yield penalties in following crop to date.

Encouraging anecdotal evidence has also come from spader demonstration strips intentionally left for comparison. In one area, 8m wide x 200m long strips, showed higher NDVI values than the surrounding untreated areas. Prior to treatment, these areas had struggled to grow much crop at all.

One challenge Tim has identified with the 'spade and sow' operation, is that it makes sowing extremely slow and would be difficult to use to sow large areas.

However, Tim is comfortable that he could work the spade and sow unit alongside the other seeder as a "complete sowing package".

Left: Canola on area which was spaded and sown (left) compared to canola sown later into non-ameliorated soil.

Right: Canola plants from un-ameliorated area (left) and spaded and sown area. [Source: Tim Polkinghorne]

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