OPTIMISING SOIL AMELIORATION COSTS IN TYPICAL MALLEE SOILS

TRIAL RUNDOWN

Multiple trials are investigating various aspects of deep ripping machinery such as tine design, attachments (wings and inclusion plates), operating depth, speed, tine spacing, the impact of shallow leading tines and of pre-ripping to improve spading.

1a. Narrow shank ripper tines

How ripping efficiency is affected by:

- speed (7 vs 4 km/h)
- depth (400 vs 600mm)
- shank design (foot and leg design features such as rake angle and width).

Equipment tested: commercially available narrow shank tines from Agrowplow #9 shank, Tilco Ag-Systems rigid shank, Grizzly Engineering Deep Digger, He-Va Sub-Tiller, and Williamson-Agri CT Michel tine ripper. These tines have not been tested for their efficiency in Australian sandy soil conditions.

1b. Mixing and delving tines

A trial is also benchmarking the draft requirements of delving tines, working at 600mm depth, at two speeds (4 vs 7 km/h). The trial is not assessing the tine ability to bring up lower soil layers to the surface.

Equipment tested: Agrowplow inversion shank, Dondi 800 series tine, He-Va Sub-Tiller tine with delving plate, Lienert clay delving tine and Bednar Terraland Active-Mix tine with narrow top mixing plate.

These wide tines are increasingly of interest to create a combination of loosening and mixing in sandy soil profiles with multiple constraints.

The range of soil amelioration technology is continually growing. With an ever-increasing array of tine shapes, sizes, attachments, and set-up configuration, it can be hard to know which equipment will do the best job.

Trials at Walpeup (VIC Mallee) and Parrakie (SA Mallee) are putting a range of ripping tines, accessories and delving tines to the test on compacted deep sands. By quantifying draft force and soil loosening, researchers can calculate the efficiency of ripping tines and other soil amelioration tools. Roughly, the more soil loosened for every unit of draft force, the more efficient the equipment is.

The trials will run twice, quantifying efficiency in good soil moisture and in dry soil. Soil loosening is more effective and energy efficient when there is some moisture in the soil. Ripping dry needs significantly more draft (and fuel), wears harder on the machines, and risks bringing up large clods in hardset soils.

Rain over spring and summer has meant selected treatments could also be compared in overly wet conditions, but some trials will be delayed until 2024, when researchers hope they can work in typically dry summer soil conditions.

2. Wings and inclusion plates

Wings on ripping tines have two key benefits – maximising the area loosened while minimising disturbance at the soil surface and minimising the draft force per unit of loosened soil area, the 'specific draft'. Although winged ripper tines are common in Europe and the USA, they have had limited uptake in Australia. Inclusion plates fitted behind the ripper tines has been an innovation specific to Australia.

Both wings and inclusion plates increase draft force requirements. This trial will quantify:

- how much extra force wings and inclusion plates can add to the base ripper tine draft
- how combining wings and inclusion plates together might affect the energy efficiency of inclusion ripping.

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Equipment tested: Agrowplow winged tip, Tilco Ag-System mulch blade kit, UniSA high lift wings (prototype), He-Va Sub-Tiller winged tine, Agrisem Cultiplow TCS tine.

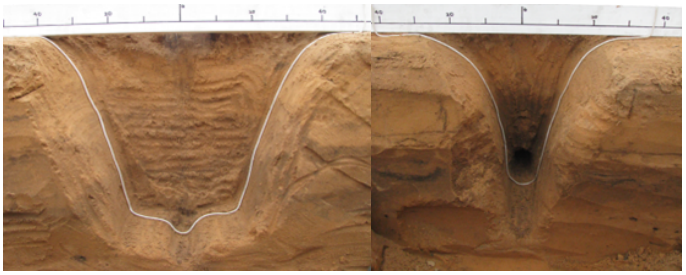


Figure 1. Winged tines (left) efficiently increase the extent of soil loosening at full depth compared to narrow shank tines (right). Photos are of loosened soil profile boundaries in a very wet sand at Walpeup, Vic.

3. Tine spacing

This trial is looking at the interaction of winged tine spacing. If wings loosen more soil, how wide should we space winged tines? A ripper with fewer and wider spaced winged tines is expected to be more efficient than a ripper with more tines without wings, to give the same amount of soil loosening.

This trial will quantify how narrow shank tine spacing affects the soil loosening performance and their specific draft:

- with and without wings
- at different depths (400mm vs 600mm).

4. Shallow leading tines

Shallow leading tines loosen the top layer of soil ahead of deeper working tines, reducing total resistance and maximising the total area loosened. Research in Europe, the UK and the USA have found shallow leading tines are an effective way to increase the ripping efficiency.

These trials will quantify the ideal leading tine configuration (in-line or offset at various spacing) to maximise deep ripping efficiency.

5. Pre-ripping when spading

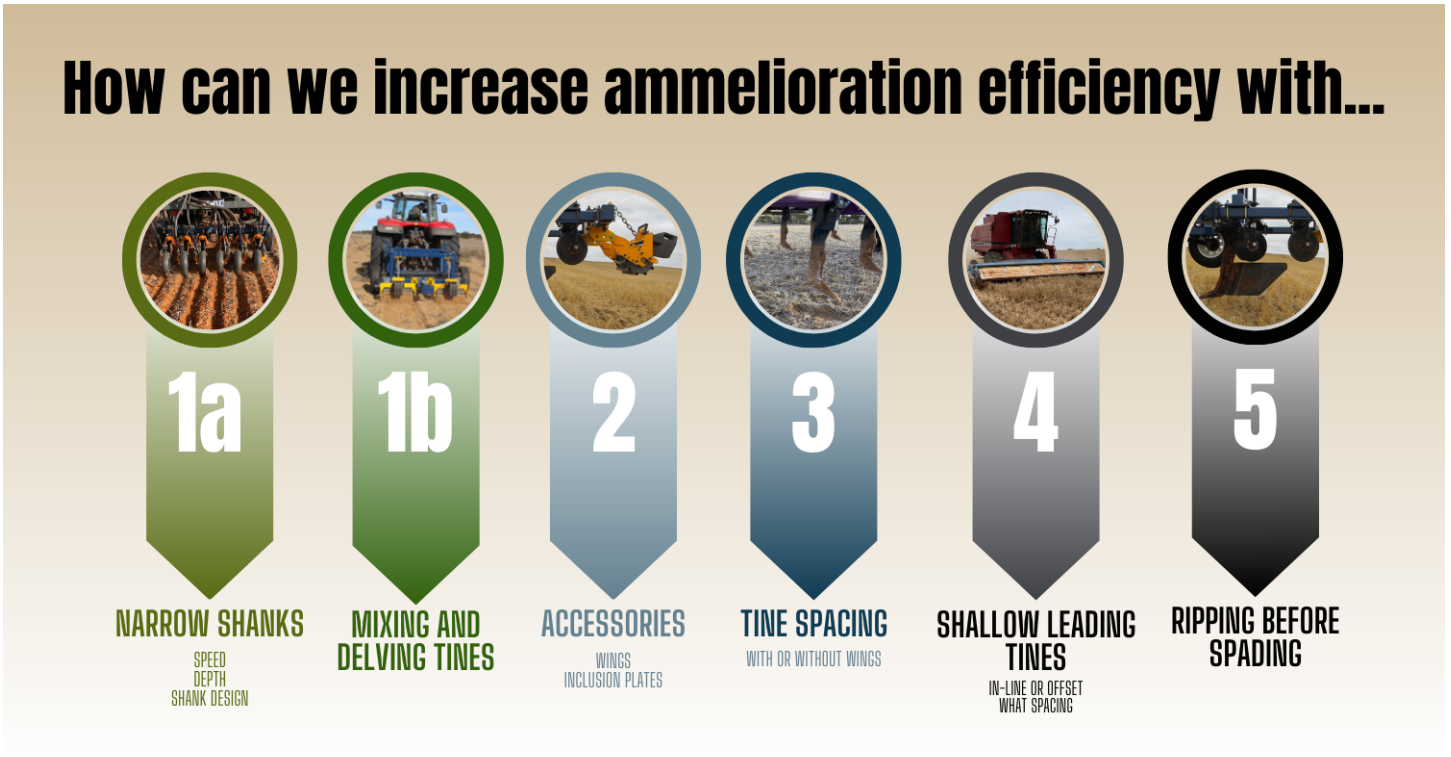
Deep ripping in front of a spader offers two key benefits. The spader needs less power to mix the soil and soil strength is reduced up to 300mm deeper than the spaded profile.

Commercial spaders now offer an integrated ripping tine carriage option to 'deep rip and spade' in one pass. This trial will evaluate:

- the power required to spade undisturbed sand vs pre-ripped sand to two ripping depths
- how spading speed (4 vs 7km/h) affects the expected spading power savings over pre-ripped conditions.

Figure 2: Collaborative research ripper frame supplied to the University of South Australia by Agrowplow-Davimac and combined with a 3-point linkage force measuring frame to evaluate the performance of a selection of ripper tine technologies in deep sand.

This project is a collaboration between the GRDC, Mallee Sustainable Farming, Frontier Farming Systems, the Agricultural Machinery R&D Centre at the University of South Australia and a number of deep ripper manufacturers.



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