

Treatment of Subsurface Acidity – Wheat trial 2004 (Established 2003)

Aim: To test a suitable relatively quick and cost-effective method of ameliorating subsurface acidity.

Research Officer: Chris Gazey

Company: Department of Agriculture WA, Centre for Cropping Systems, Northam

Farmer: Garry Helliwell

Location: Maya



Department of Agriculture
Government of Western Australia



Background: Productive agriculture in the cropping regions of southwestern Australia has resulted in the development of subsurface acidity. The acidity is greatest at between 15–40 cm depth. Lime is sparingly soluble and the movement of alkalinity from lime applied at the surface and left there or incorporated into the top 5–10 cm of soil is too slow to rapidly ameliorate subsoil acidity. The alkalinity only starts to move downward at a reasonable rate when topsoil acidity is greater than pH 5.5, measured in calcium chloride. Because soils have been allowed to acidify, the pH of most unlimed sandy topsoils in the region is around 4.0. Several surface applications of lime over a number of years are necessary before the topsoil pH is raised sufficiently for the alkalinity to move down and ameliorate subsurface acidity.

The sandplain soils in the region need to be deep ripped to ameliorate a physical hard pan developed when vehicles and machinery move over soil while farming. For these soils, an alternative solution to treat subsurface acidity is to deep place lime between 15–30 cm deep in soil while deep ripping the soils. This approach was tested in this experiment in 2003. About 1 t/ha limesand can be blown down to the depth using an air seeder and tined implements similar to those used for deep ripping sandy soils.

Trial Details:

Plot size and replication	7.5m x 50m
Soil type	Deep Sand
Sowing date	30 th May 2004
Conditions at sowing	Moist
Machinery	No til
Seeding rate	60 kg/ha Arrino Wheat, triad on fertiliser
Fertiliser	MAPS TE 30% NPK 70% at sowing @ 90 kg/ha, urea @ 90 kg/ha pre
Herbicides and Insecticides	Pre seeding: Roundup 1.2 L, Treflan 1.6L, Shirquat 700mLs, Diuron 185g Post seeding: lve MCPA 435mLs, Lontrel 20g, Logran 7g
Paddock History	2003 = Barley

The 8 treatments **applied in 2003** were:

1. **Control:** no ripping and no product applied.
2. **Deep ripping only:** deep ripped at 35 cm, no product applied.
3. **Deep place low amount (half maximum amount) of limesand while deep ripping:** total of 0.5 t/ha limesand applied, 0.25 t/ha at 15 cm and 0.25 t/ha at 25 cm, while deep ripping at 35 cm.
4. **Deep place highest amount of limesand while deep ripping:** total of 1 t/ha limesand, 0.5 t/ha at 15 cm and 0.5 t/ha at 25 cm, while deep ripping at 35 cm.
5. **Deep place highest amount of dolomite while deep ripping:** total of 1.8 t/ha dolomite, 0.9 t/ha at 15 cm and 0.9 t/ha at 25 cm, while deep ripping at 35 cm.

Other Research and Development Results

6. **Deep place highest amount of gypsum while deep ripping:** total of 1.2 t/ha gypsum. 0.6 t/ha at 15 cm and 0.6 t/ha at 25 cm, while deep ripping at 35 cm.
7. **Deep place a 50:50mixture of limesand and gypsum at the highest amount of mixture while deep ripping:** total of 0.6 t/ha limesand and 0.6 t/ha gypsum, 0.3 t/ha limesand and 0.3 t/ha gypsum at 15 cm, and 0.3 t/ha limesand and 0.3 t/ha gypsum at 25 cm while deep ripping at 35 cm.
8. **Deep place a mixture of limesand, at the highest amount of limesand, and potassium chloride (100 kg/ha muriate of potash) while deep ripping:** total of 1 t/ha limesand and 100 kg/ha potassium chloride, 0.5 t/ha limesand and 50 kg/ha potassium chloride at 15 cm and 0.5 t/ha limesand and 50 kg/ha potassium chloride at 25 cm, while deep ripping at 35 cm.

There were 2 tubes placed behind each tine on the deep ripping machine used at Maya, the outlet of one tube was 10cm above the ripping tine, and the outlet of the other tube was 20cm above the ripping tine and 10cm above the outlet of the other tube. There were 10 deep ripping tines 350cm apart (about 14 inches apart).

The trial area was resown to wheat as detailed above in 2004 and harvested using a weigh trailer and yield monitor, both methods of yield assessment gave similar results.

Results:

Responses in plant growth were observed during the growing season of 2004 to all treatments that had been deep ripped in 2003. Grain yield for the treatments are presented in the table below. The only significant difference was between the unripped control and all other treatments which had been ripped in 2003. The paddock average for 2004 was 2.5 t/ha wheat.

Treatment	Grain Yield (t/ha)
Control: no ripping and no product applied	2.33
Deep ripping only	2.70
Deep place half maximum amount of limesand	2.62
Deep place highest amount of limesand	2.68
Deep place highest amount of dolomite	2.67
Deep place highest amount of gypsum	2.61
Deep place a 50:50mixture of limesand and gypsum at the highest amount of mixture	2.58
Deep place a mixture of limesand, at the highest amount of limesand, and potassium chloride (100 kg/ha muriate of potash)	2.69

Summary:

- Before attempting subsurface lime incorporation it is essential that the pH profile be known. Soil testing the 10-20 cm depth is strongly recommended.
- Incomplete amelioration of the profile due to poor delivery of product and/or excess speed can leave a highly acidic layer above the ameliorated layer which can reduce the effectiveness of the treatment.
- There was a significant response to deep ripping and the removal of a traffic pan on this soil which has continued into the second year.
- Arrino wheat is rated as having good tolerance to acidity.
- Further work will continue in 2005 to determine the best way to ameliorate subsurface acidity.