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Clay spreading on water repellent deep sand

Giacomo (Jack) Betti and Steve Davies, Research Officers, DAFWA

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Purpose:	To compare different clay spreading and tillage methods for the amelioration of water repellent deep pale sand.
Location:	Badgingarra (C. McAlpine)
Soil Type:	Pale deep water repellent sand
Rotation:	2016 Lupin

BACKGROUND SUMMARY

There is an increased interest in clay spreading as an option for the management of water repellent soils in the northern Wheat Belt. Clay spreading is a proven method for the amelioration of the water repellence and the improvement of productivity but it requires high initial capital investments and the outcomes can be quite variable. Moreover, some evidence suggests that in medium-low rainfall areas there is a potential for negative outcomes following excessive applications of clay.

The aim of this trial is to identify the best combination/s of clay application rate and the subsequent method of incorporation in the topsoil (in combination with deep ripping) in order to increase the cost-effectiveness of this soil amelioration option in the northern region.

TRIAL DESIGN

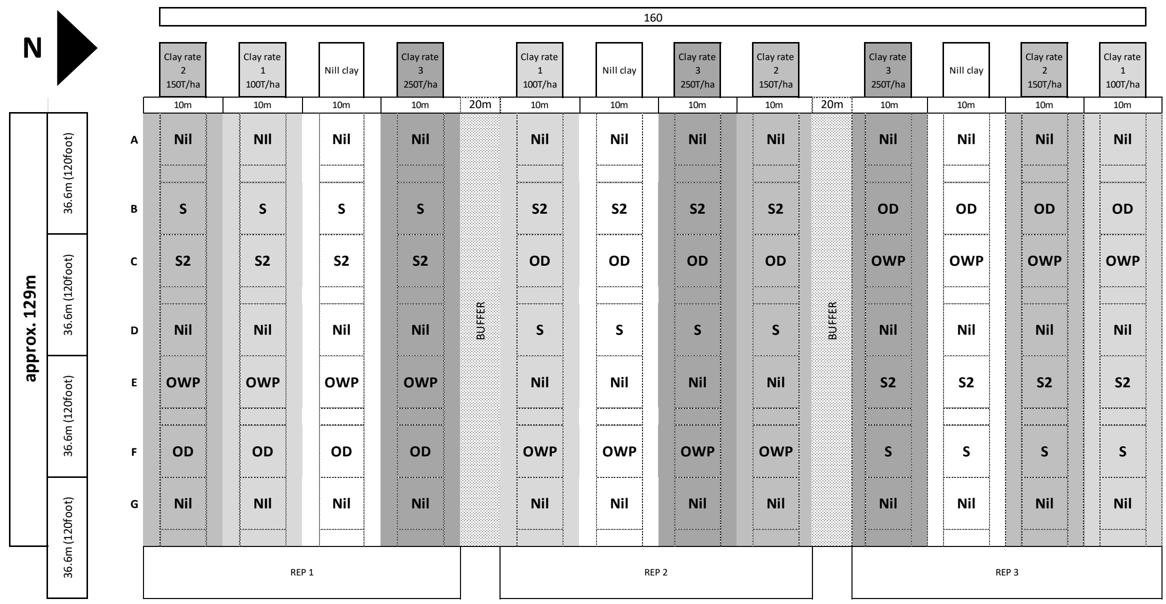
The trial at Badgingarra was replicated on three randomized blocks. On March 2016, 4 rates of subsoil clay (0, 100, 150 and 250t/ha) were spread perpendicular to the direction of seeding using a multi-spreader. The subsoil clay (approximately 50% of clay content) was sourced from a pit approximately 1km away from the trial.

Clay spreading was followed by either no further incorporation or incorporation using four different methods (from low to high degree of mixing): i) off-set disc, ii) one-way disc plough, iii) rotary spader (single pass) and iv) 2 passes of rotary spader. After the clay spreading and prior to the incorporations by tillage, the trial was deep ripped to about 400mm in order to remove subsoil compaction. Operational costs are presented in Table 3.

Plot size: 10m x 18.3m (trial size 160m X 129m)

Machinery use: Nufab multi-spreader, deep ripper, Farmax rotary spader, offset disc, one-way disc plough and digger (clay pit excavation and clay spreader loading)
Repetitions: 3 replicas
Crop type and varieties used: Barlock Lupin
Seeding date: 26 April 2016

TRIAL LAYOUT



S= SPADER (SINGLE PASS); **S2**= SPADER X 2 PASSES; **OD**= OFF-SET DISC; **OWP**= ONE-WAY PLOUGH; **Nil**= NO INCORPORATION

RESULTS

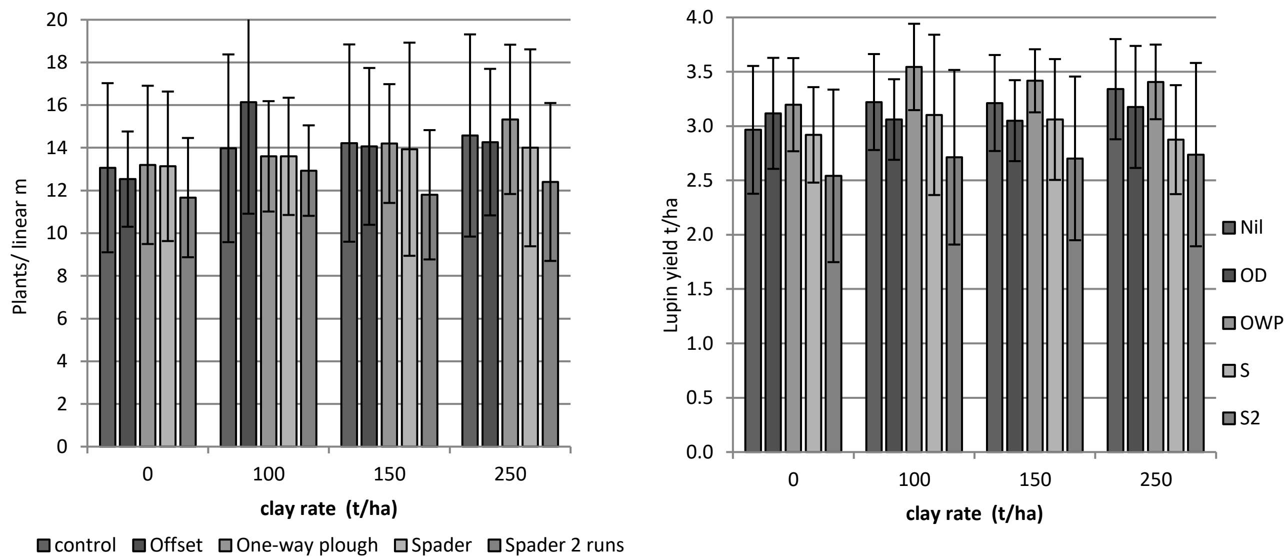


Figure 1. Left: effect of the treatments on early plant establishment. Right: effect of the treatments on grain yields of lupin

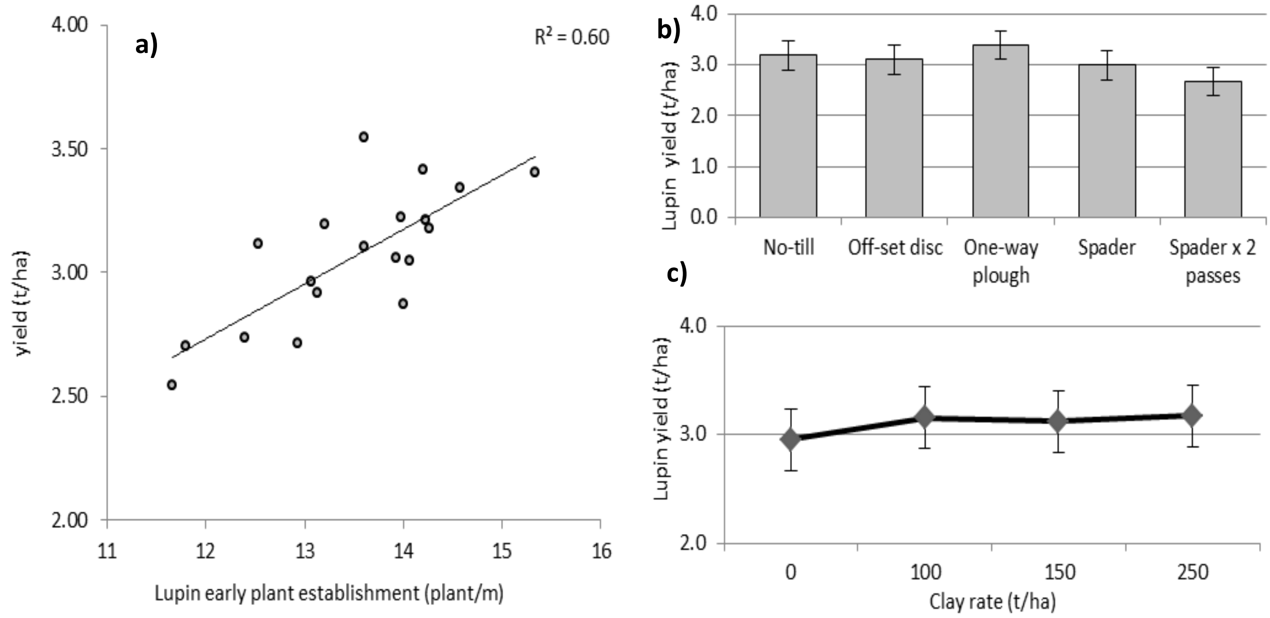


Figure 2. a) Correlation between lupin establishment and grain yield. b) Average effect on yield of the tillage methods (with and without clay spreading). c) Average effect of rate of subsoil clay on yield (with and without tillage for incorporation)

FINANCIAL ANALYSIS OF RESULTS

Table 1. Estimated costs of the clay spreading and tillage treatments

Cost of treatments			
Clay spreading		**Incorporation**	
Rate of subsoil clay (t/ha)	**Estimated cost ($/ha)**	**Tillage**	**Estimated cost ($/ha)**
100	270	**Off-set disc**	15-25
		One-way plough	15-25
150	410	**Spading**	85-110
250	720	**Spading 2 passes**	150-200
Crop-specific direct costs & market price			
Crop		**Direct costs[1] ($/ha)**	**Market price[2] ($/t)**
Barlock Lupin		350	275

[1]Direct costs are seed, fertiliser, herbicides etc. [2]Best market price available in December 2016

DISCUSSION

Lupin establishment as measured by plant counts conducted five weeks after sowing is presented in Figure 1 (left). The values were very variable and reflected the “patchiness” observed in the treatments. The result may be explained by irregular seeding depth, a well-known issue when seeding on newly renovated soils. Uneven soil surface and low soil bulk density after tillage are the reasons why often the seeds are sown too deeply, which can delay or restrict germination. Also, the wetter than usual weather during April-May (over the 9th decile) may have reduced the severity of water repellency and thus the potential differences in crop establishment between the control and the other treatments. Increasing amount of clay applied to the soil was found to significantly increase the number of plants. The incorporation methods (tillage) had also a significant (and generally negative) effect on crop establishment with the more intensive incorporations (spading 1 or 2 passes) reducing the number of plants, even in comparison of the control treatments (Figure 1, left).

The mean grain yields for lupin are shown in Figure 1 (right). The control treatments (no clay and no tillage) yielded 3 t/ha on average and the addition of clay without incorporation increased the yield by up to 0.3 t/ha. The best yields obtained when the one-way plough was combined with clay spreading, with an average of 3.4-3.5 t/ha. As per the case with early plant establishment, the more intense tillage approaches produce the lowest yields, particularly when not combined with clay spreading. As expected, yields were influenced by the early plant establishment as shown by the linear correlation in Figure 2a. Overall, tillage methods had a significant and negative effect on yield, with only the one-way plough tillage having a positive effect in comparison to the control treatment (Figure 2b). Yields increased with increasing incorporation of subsoil clay, although the result was not statistically significant (Figure 2c).

With the exceptions of the treatments clay spread at the rate of 250 t/ha and the clay treatments combined with two passes of rotary spader, the gains obtained with most treatments were able to “pay off” the whole direct costs (crop-specific direct costs only + treatment specific costs, as per mean values in Table 1) in the first growing season. However, only one tillage treatment produced a better return of investment (ROI= ($/ha gain – $/ha total direct costs) / $/ha total direct costs) than the control plots (with ROI=1.33 $/ha, data based on mean values presented in Table 1): the one-way plough treatment without claying (ROI=1.34 $/ha) which was followed by off-set disc without claying (ROI=1.29 $/ha). These estimates are indicative only, as indirect costs and interests on the initial capital investment are not included in the calculations.

The trial will be monitored for the next 3 years, allowing for more accurate estimates of ROI from each treatment.

PAPER REVIEWED BY:
Andrew Blake, DAFWA

CONTACT DETAILS:
Giacomo Betti DAFWA
Email: Giacomo.betti@agric.wa.gov.au
M: 0447163901