Clay spreading on water repellent sandy gravel

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Purpose:	To compare different clay spreading and tillage methods for the amelioration of water repellent gravel soils.
Location:	Moora
Soil Type:	Water repellent sandy gravel
Rotation:	2014, 2015 and 2016 wheat

BACKGROUND SUMMARY

Clay spreading is a well adopted and effective method for the amelioration of the water repellent sandy soils. The interest for this technique is also increasing in those areas where the water repellent soils are often characterised by high gravel content. Hence, there is a need for a better understanding on how to best approach clay spreading in soils where the presence of gravel brings new challenges in terms of the application rates and, above all, the following incorporation in the topsoil.

One hypothesis is that gravel soils will require much smaller application rates of clay in comparison to similarly water repellent deep sands (due to their smaller volume of water repellent sand per volume of total soil), so that the high cost for clay spreading could be significantly reduced.

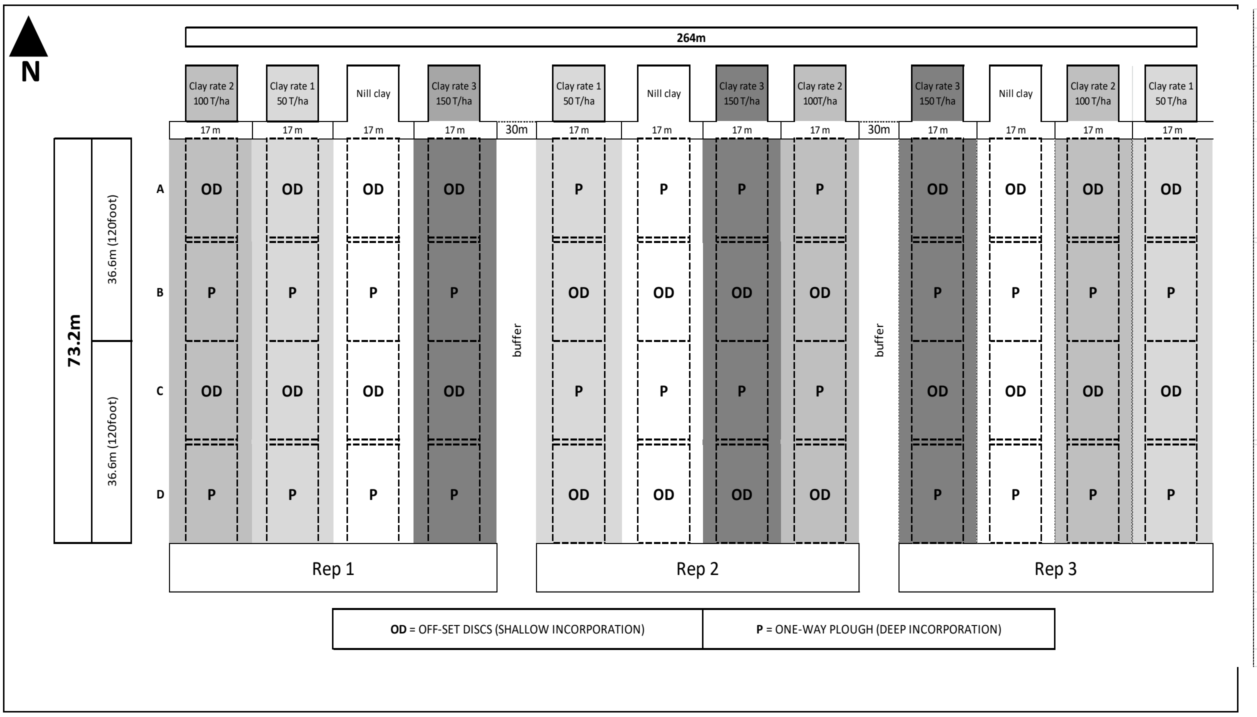
The aim of this trial is to evaluate the potential for clay spreading on gravel sands by looking at different application rates of clay and methods of incorporation.

TRIAL DESIGN

The clay spreading trial at Moora is repeated on three randomized replica blocks. On each block, 4 rates of subsoil clay (0, 50, 100 and 150t/ha) have been spread perpendicular to the direction of seeding using a multi-spreader. The chosen clay rates were half of the rates used in other trial on deep sand. This choice was based on the hypothesis that approximately half of the volume of soil was water repellent sand and needed to be clayed, since the other half was occupied by gravel. Clay spreading was followed by incorporation using two different methods: i) off-set disc (shallow incorporation) and ii) one-way disc plough (deep incorporation). Operational costs are presented in Table 1.

Plot size: 17m x 18.3m (trial size 264m X 73.2m)
Machinery use: Nufab multi-spreader, one-way disc plough, off-set disc, digger (clay pit excavation and clay spreader loading)
Repetitions: 3 replicates
Crop type and varieties used: Mace wheat
Seeding dates: June 1st (approx.)

TRIAL LAYOUT



RESULTS/STATISTICS

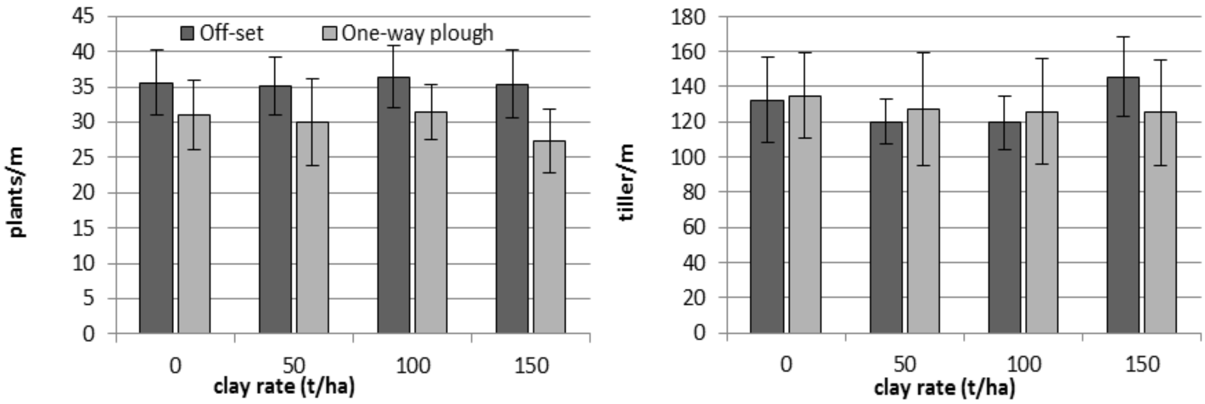


Figure 1. Effect of the treatments on plant establishment assessed by plant counts 4 weeks after sowing (left) and by tiller counts 8 weeks after sowing (right). Error bars represent standard deviation of the means

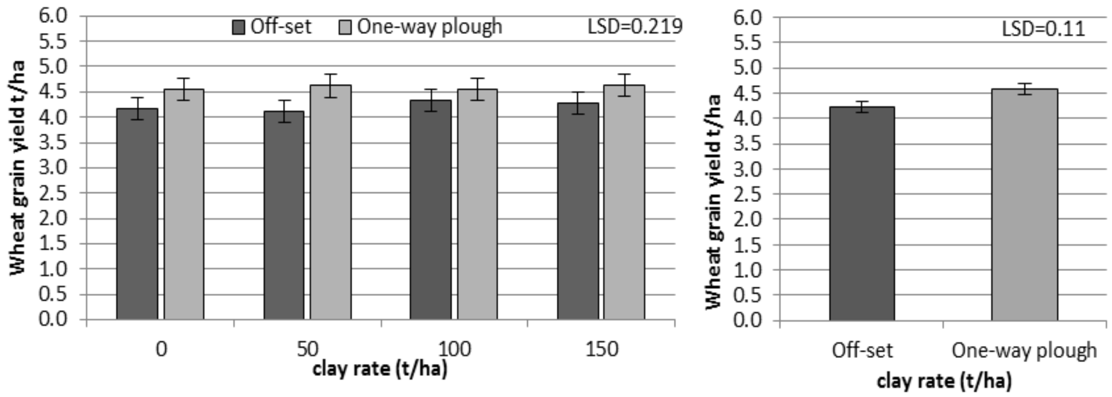


Figure 2. Left: effect of the treatments on grain yields. Right: mean effect of the incorporation tillage on grain yields. Error bars represent the average least significant difference (LSD)

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)**
50	135	**Off-set disc**	15-25
100	270		
150	410	**One-way plough**	15-25
Crop-specific direct costs & market price			
Crop		**Direct costs[1] ($/ha)**	**Market price[2] ($/t)**
Mace Wheat		450	250

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

DISCUSSION

A summary of the main results from the first season at the Moora trial are presented in Figures 1 and 2. Due to technical issues, the trial was not seeded at the same time as the rest of the paddock, which was supposed to be used as an untreated control. For this reason, a comparison of the treatments to a control treatment without tillage and clay spreading is not available. A statistically significant effect of tillage on early plant establishment was found when analysing the plant counts measured about four weeks after sowing (Figure 1, left). All the treatments with the off-set disc (in combination or not with clay spreading) had more plants per linear meter in comparison to the one-way plough treatments. This is likely due to uneven seeding depth following tillage with the one-way plough (deep tillage) compared to the shallower tillage with the off-set disc. Surprisingly, incorporation of subsoil clay at any given rate did not show any significant effect on early plant establishment although this result could be explained by the wetter than usual weather in April-May reducing the severity of soil water repellence.

Again, when looking at the tiller counts recorded 8 weeks after sowing (Figure 1, right) the addition of clay at different rates did not affect the number of tillers. However, the wheat growing in the one-way plough treatments overcame the initial delay in germination giving higher tiller number than those recorded in the treatments with the off-set disc (except for the treatment with 250 t/ha of clay). This trend continued at harvest, with the one-way plough treatments producing higher yields (4.5-4.6 t/ha on average) than the off-set disc treatments (4.1-4.3 t/ha on average) at any given rate of subsoil clay.

Due to the low rates of clay spreading and the low cost of the incorporation methods, all treatments provided a positive return of investments in the first year (ROI= ($/ha gain – $/ha total direct costs) / $/ha total direct costs), based on mean values in Table 1. Not surprisingly, the best ROI in the first year was obtained by the one-way plough treatment without clay spreading (1.42 $/ha), followed by the off-set disc without clay spreading (1.22 $/ha) and the treatments clay spread at 50 t/ha incorporated with one-way plough (1.17 $/ha). These estimates are indicative only, as indirect costs and interests on the initial capital investment are not included in the calculations. For more accurate estimates of ROI, yield results from multiple seasons and crops will be collected in the next 3 years.

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