Improving soil fertility on poorly drained soils

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Summary

- Liming is critical in improving nutrient availability & efficiency.
- The response of soil pH to lime application is reduced as soil clay content increases.
- 70 kg surplus phosphorus (P)/ha is required to increase soil test P by 1 mg/l on heavy mineral soils.
- Granulated lime is 5.9 times more expensive than ground lime.
- Herbage production difference between P Index 1 and 3 is 1 t DM/ha.

Introduction

Poor soil fertility is a major limiting factor on output potential of farms in Ireland, particularly farms dominated by fine particle size and/or high organic matter content (peat soils). Lime application aids the increase of nutrient availability and efficiency, it assists the growth of ryegrass and clover, and it accelerates the activity of nitrogen fixing bacteria and earthworms which in turn improves soil physical structure. Of the soil samples analysed in Ireland in 2020, only 21% were optimum in soil pH, P and K, in comparison to 15% of paddocks on the 'Heavy Soil Programme' (HSP) monitor farms. The HSP was established in 2011 in order to assess the overall potential of these soils.

Phosphorus can pose a major risk to water quality, particularly when used excessively or when managed poorly. Due to the risk legacy P poses to water quality and the large variation of P input required to optimise plant P availability, a soil specific approach is required to minimise the accumulation of excessive P in soil, reduce its environmental impact and increase P use efficiency. Controlled studies have been developed to isolate soil specific responses to lime and P application on heavy soils.

Liming

Soil acidity, lime application rate, lime type and effects on nutrient availability, soil structure and herbage production have been assessed. Achieving optimal soil pH (≥6.3) is crucial to ensure soil functions are optimised. Equivalent rates of ground and granulated lime application are required to achieve similar changes in soil pH on these particular soils. One t/ha of each lime product increased soil pH by 0.15 and 0.21 pH units, respectively. For a similar increase in soil pH, granulated lime proved 5.9 times more expensive than ground lime. The lower the clay content the greater the increase in soil pH (Figure 1). Liming increased soil test P and herbage production and showed no negative effect on soil physical structure. Increasing soil pH by one pH unit increased herbage production by 1.3 t DM/Ha.

Phosphorus

The effects of P application on the HSP farms with regards to soil fertility, agronomic potential and their potential risk to the environment have been assessed. Results show that liming and counteracting soil acidity is fundamental to increasing P availability and also reducing P loss potential. Similar to pH, P availability is largely influenced by the level of clay content in the soil and the concentration of iron and aluminium cations; 50 kg P/ha was required to achieve sufficient soil P concentration to support healthy plant growth and also increased soil test P by 0.45 mg/l. Organic soils (>20% OM) pose a major threat to water quality if excessive P is applied. Achieving optimum soil P index (Index 3) will increase herbage production by 1 t of DM/ha (Figure 2).

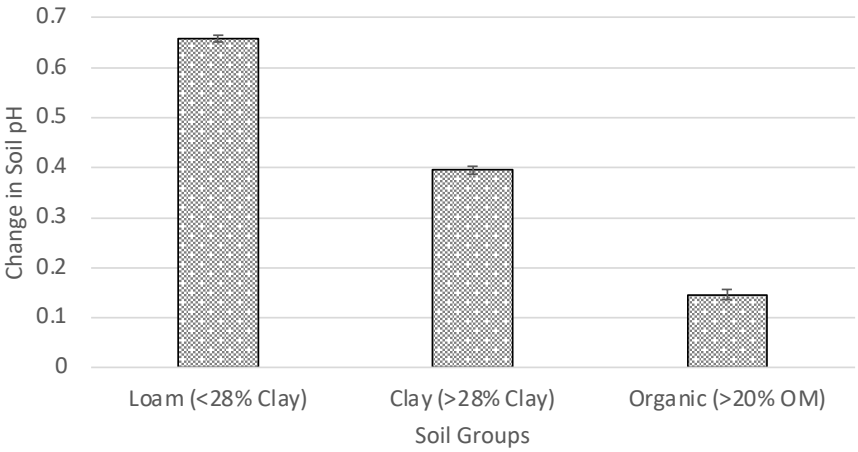

Figure 1. *Change in soil pH applying five tonne lime/ha across soil groups*

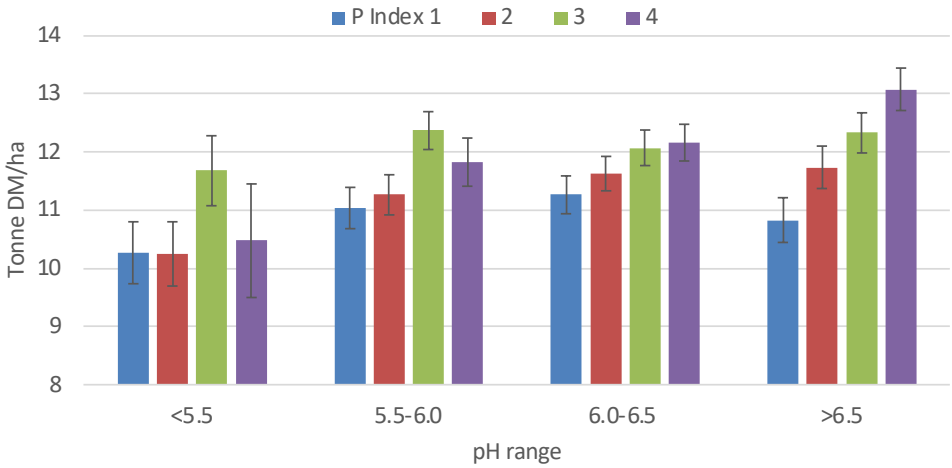

Figure 2. *Effect of soil pH range and soil P index on herbage production*

Conclusion

Currently in Ireland, standard P recommendations for mineral soils do not take into account the variability in soil type response and soil specific requirements. A more strategic approach is required to increase soil fertility and productivity on heavy soils. Soil texture and chemical composition influence the fate and efficiency of applied P. Liming to achieve optimum soil pH (≥6.3) is fundamental to buffer the soil and increase herbage production. Heavy mineral soils have a large affinity for P and therefore improving soil test P status can be very slow.