The effect of soil fertility levels and nitrogen, phosphorus and lime application rates on herbage production and herbage phosphorus content.

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Message

- Strong influence of soil P levels on herbage P concentration
- Positive interaction between P fertilizer and lime increased soil P availability
- The addition of P fertilizer lead to an increase in herbage yield at both sites

Introduction

Phosphorus (P) fertilizer use and soil P fertility levels have been declining in Ireland in recent years. As a result there is now increased emphasis on improving the efficiency of P fertilizer use. This experiment was established to investigate the interactive effects of additions of nitrogen (N), P and lime on herbage dry matter production and herbage P content over a two year period.

Methods

Experimental plots were established on a newly reseeded perennial ryegrass sward at two locations in Ireland in June 2011. Site 1 had a low soil test P (STP) concentration of 4.83 mg L\(^{-1}\) Morgan’s P and a soil pH of 5.39. Site 2 had a high STP concentration of 14.92 mg L\(^{-1}\) Morgan’s P and a soil pH of 6.17. Four rates of fertilizer (0, 20, 40 and 60 kg P ha\(^{-1}\) yr\(^{-1}\); as 16% P) were applied at the start of each year. Nitrogen fertilizer (CAN) was applied after each grass harvest to give annual rates of 0, 150 and 300 kg N ha\(^{-1}\) yr\(^{-1}\). Lime (0 & 5 t ha\(^{-1}\)) was applied at the start of the experiment. After establishment, experimental plots were harvested with a self propelled lawnmower every 4-5 weeks during the grass growing season for a 2-year period. Four grass harvests were taken during 2011 and 8 during 2012.

Results

- Application of N fertilizer increased herbage yield at both sites.
- At site 1, herbage yield was increased by P application up to 40 kg ha\(^{-1}\) yr\(^{-1}\) (Fig. 1).
- At site 2, herbage yield was increased by P application of 20 kg P ha\(^{-1}\) yr\(^{-1}\) (Fig. 1).
- Phosphorus fertilizer increased the herbage P concentration and there was a strong positive correlation between the herbage P concentration levels and soil (Morgan’s) P levels in the soil.
- Lime increased herbage yield and decreased herbage P content at site 1, but had no effect at site 2.
- Applying P fertilizer and lime significantly increased soil (Morgan’s) P levels (Fig. 2).

Discussion/Conclusions

The response to P and lime application was expected at site 1 which had the lower Morgan’s P and soil pH. However, the herbage yield response to P at site 2 was not expected based on existing advice in Ireland and work is continuing to further understand this result and the potential effect of the S present in the P fertilizer. Lime had a strong influence in increasing soil P availability in both sites.

Acknowledgments

This work is funded by Teagasc by the Walsh Fellowship Scheme.

Fig. 1. Effect of P fertilizer on the herbage yield (different letters denote significant difference within site) (P>0.05))

(a) Site 1  
(b) Site 2

Fig. 2. Effect of P and lime on the soil test P levels after year 2 in site 1 (a) and site 2 (b) (error bars denote std err)

(a) Site 1  
(b) Site 2