Making fertilizer practices efficient using polyhalite

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Abstract

Inappropriate application of nitrogen has resulted in environmental impacts that have led to strict environmental regulation in Europe and elsewhere. Similarly, phosphorus impacts the environment by entering waterways, as a result of soil erosion, causing eutrophication. In England alone, 60% of nitrates and 25% of phosphates originate from agricultural land. At the same time, farmers need to increase yields to be able to feed a world population of 9.8 billion by 2050 whilst being environmentally responsible. Therefore, farmers need to adapt to meet future challenges.

Since food demand will double within 30 years, fertilizer use efficiency is receiving attention. Post-harvest crop biomass is commonly incorporated and is acknowledged as a nutrient source to subsequent crops. The system is recognised as more efficient and less prone to nutrient losses by leaching, for example.

The recent discovery of the world's largest deposit of polyhalite ($K_2SO_4.MgSO_4.2CaSO_4.2H_2O$) has raised interest due to the mineral being used as a multi-nutrient fertilizer. Its validation as an efficient fertilizer source required commissioning of an extensive research programme that, to date, consists of 327 trials on 35 crops in 24 different countries.

Introduction

- Field trials were carried out between 2013 and 2017 investigating the yield response of broad-acre and high-value crops to a commercial polyhalite granular product (POLY4).
- In use at commercially-recommended rates as a potassium source we compared POLY4 to potassium chloride (muriate of potash, MOP) and potassium sulphate (sulphate of potash, SOP) or a blend of MOP + POLY4 fertilizers.
- Whilst adopting the correct measure for fertilizer use efficiency can be problematic, here we suggest a simple cumulative uptake at harvest as comparative measure.

Method

- Moderate K-status plots were selected for 138 trials.
- Experimental design at each site was a randomized block design with four replications.
- Recommend nitrogen (N) and phosphorus (P) were applied as urea and diammonium phosphate to all plots.
- Control treatments received only N and P applications.
- Soil samples were taken prior to drilling and chemical analysis for the major and minor nutrients was undertaken.
- Macro-nutrient uptake is expressed as normalized to that result of N+ P + MOP representing 100% of nutrient uptake in above ground biomass.
- Statistical analysis was carried out using Genstat software version 19 (VSN International, 2011).

Table 1

Summary of pre-trial soil nutrient status

Soil measurement	Value (± Std Dev)
P (mg kg^{-1})	18 (±18)
K (mg kg^{-1})	97 (±44)
Mg (mg kg^{-1})	125 (±63)
Ca (mg kg^{-1})	1443 (±796)
S (mg kg^{-1})	65 (±55)
OM (g kg^{-1})	22 (±7.6)
pH	6.0 (±1)

Figure 1

Average normalised POLY4 performance against other potassium sources

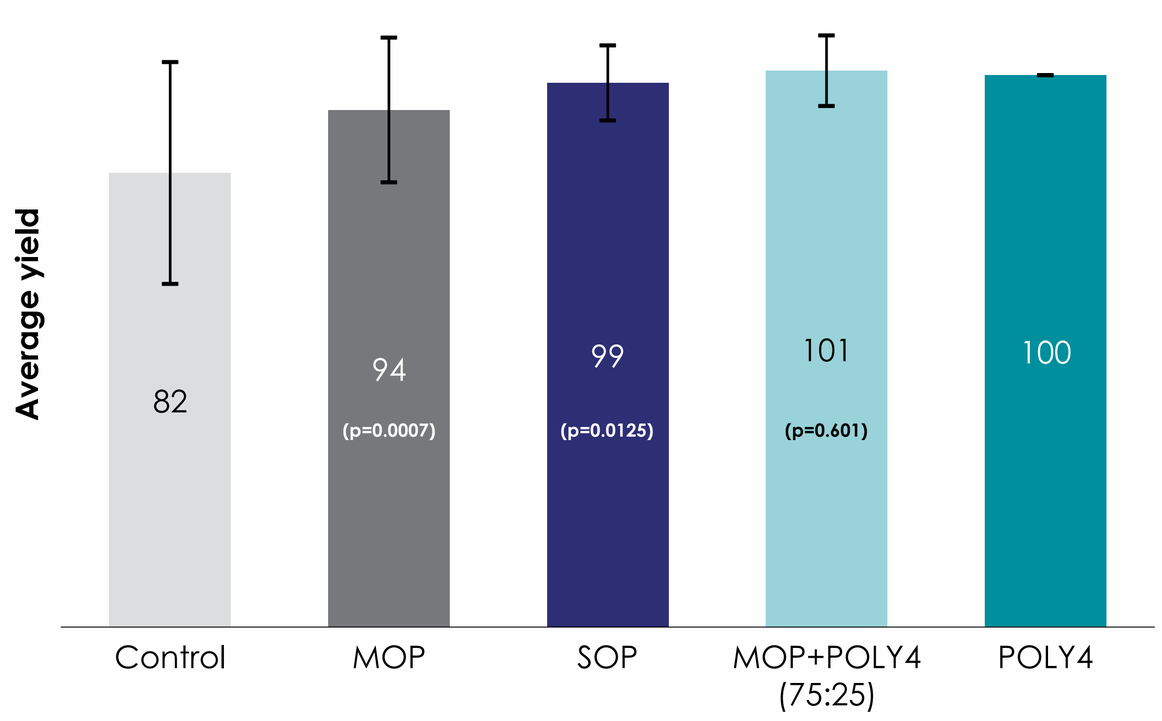
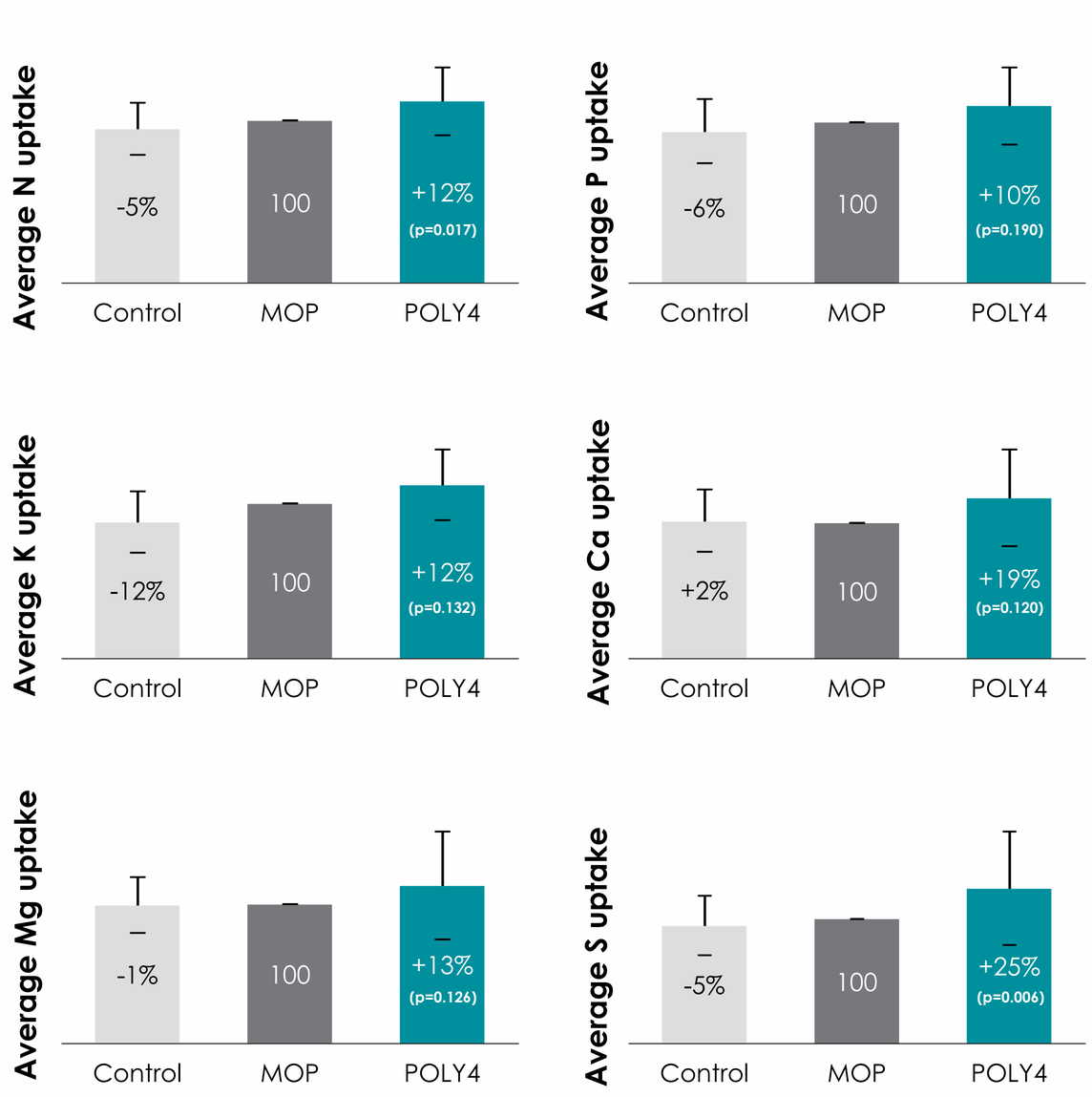


Figure 2

Average normalised POLY4 performance against other potassium sources



Results & Discussion

- Yield results are presented (Figure 1) as average normalized yield where POLY4 represents 100%, with Tukey mean comparisons P=0.05.
- Nutrient uptake results are presented (Figure 2) as average normalized yield where POLY4 represents 100%, with Tukey mean comparisons P=0.05.
- Mean soil analyses results are presented in Table 1 and are pertinent to the yield and nutrient accumulation results.
- Evidence suggests a major K response on these soils.
- An incremental yield response is indicated with additional S, Mg and Ca.
- When the potassium need is supplied from a split of 75% K from MOP and 25% K from POLY4, the yield result is maximized.
- Data suggest that 65% of occasions a MOP + POLY4 potassium value as a yield advantage over SOP (data not shown).
- Data suggest that on 75% of occasions a MOP + POLY4 potassium value as a yield advantage over MOP alone (data not shown).
- This indicates the frequency at which the additional magnesium, calcium and a fertilizer plan low in chloride makes a yield contribution.
- Nutrient capture and accumulation in to above ground parts is primarily driven by higher biomass numbers (data not shown).
- Large increments in nutrient accumulation seem to results where POLY4 is utilized in a fertilizer plan as the K source. By this measure, this indicates an improved FUE.

References

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