Sustaining the future.

SIRIUS MINERALS PLC

# AVAILABILITY OF POTASSIUM AND SECONDARY NUTRIENTS FROM POLY4 AND THEIR SIGNIFICANCE FOR SOYBEAN PRODUCTION

**ASA & CSSA Annual Meeting 2018**

**Enhancing productivity in a changing climate**

Presentation by Rachel Fields

6 November 2018

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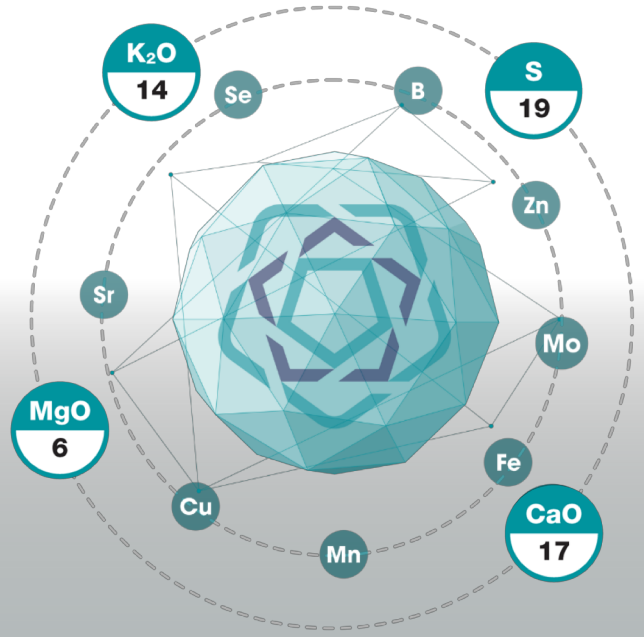
# INTRODUCTION TO POLY4 – POLYHALITE-BASED FERTILIZER

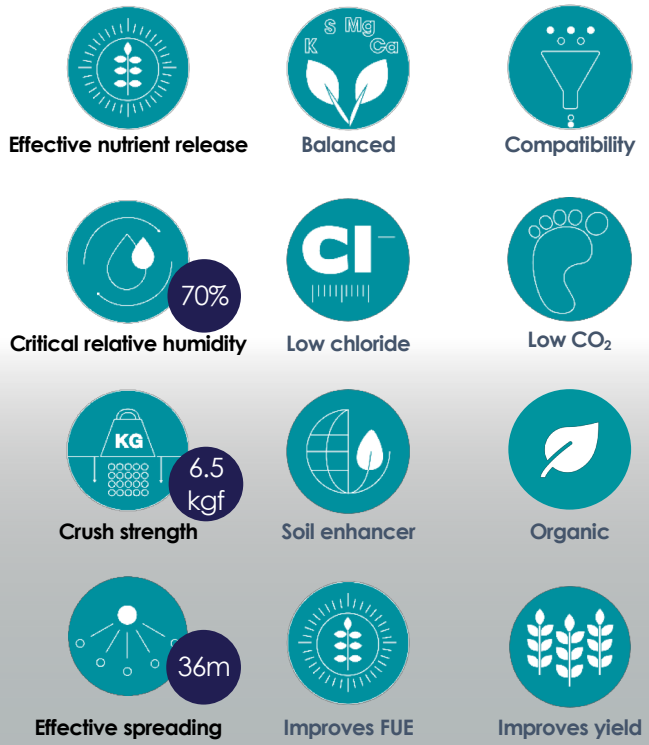
## ($K_2SO_4.MgSO_4.2CaSO_4.2H_2O$)

A single source of bulk nutrients as foundation for effective, efficient, flexible and sustainable fertilization.

### Characteristics

- Improves yield and quality
- Straight or as part of a fertilizer blend
- Efficient nutrient release profile
- pH neutral




OF&G ORGANIC

Notes: 1) Based on 90% polyhalite grade. Macro nutrients based on w/w % and micro nutrients based on mg/kg; micro nutrients' content: B 169, Zn 1.9, Mn 3.1, Mo 0.3, Se>0.5, FE>0.5, Cu 1.1, Sr 1414. 2) POLY4 is the trademark name for polyhalite products from the Sirius Minerals polyhalite project in North Yorkshire, *48% $SO_3$. B – boron, Cu – copper, Se – selenium, Zn – zinc, Fe – iron, Sr – strontium, Mo – molybdenum, Mn – manganese.

# LEACHING COLUMN STUDIES – MARCEL, UNIVERSITY OF FLORIDA

## Methods

**Leaching columns:** made from PVC pipe (400 mm long and 50.8 mm internal diameter).

**Soil:** Ankona sandy loam from Florida.

**Fertilizers:** POLY4, muriate of potash (MOP), sulphate of potash (SOP) and sulphate of potash magnesium (SOP-M).

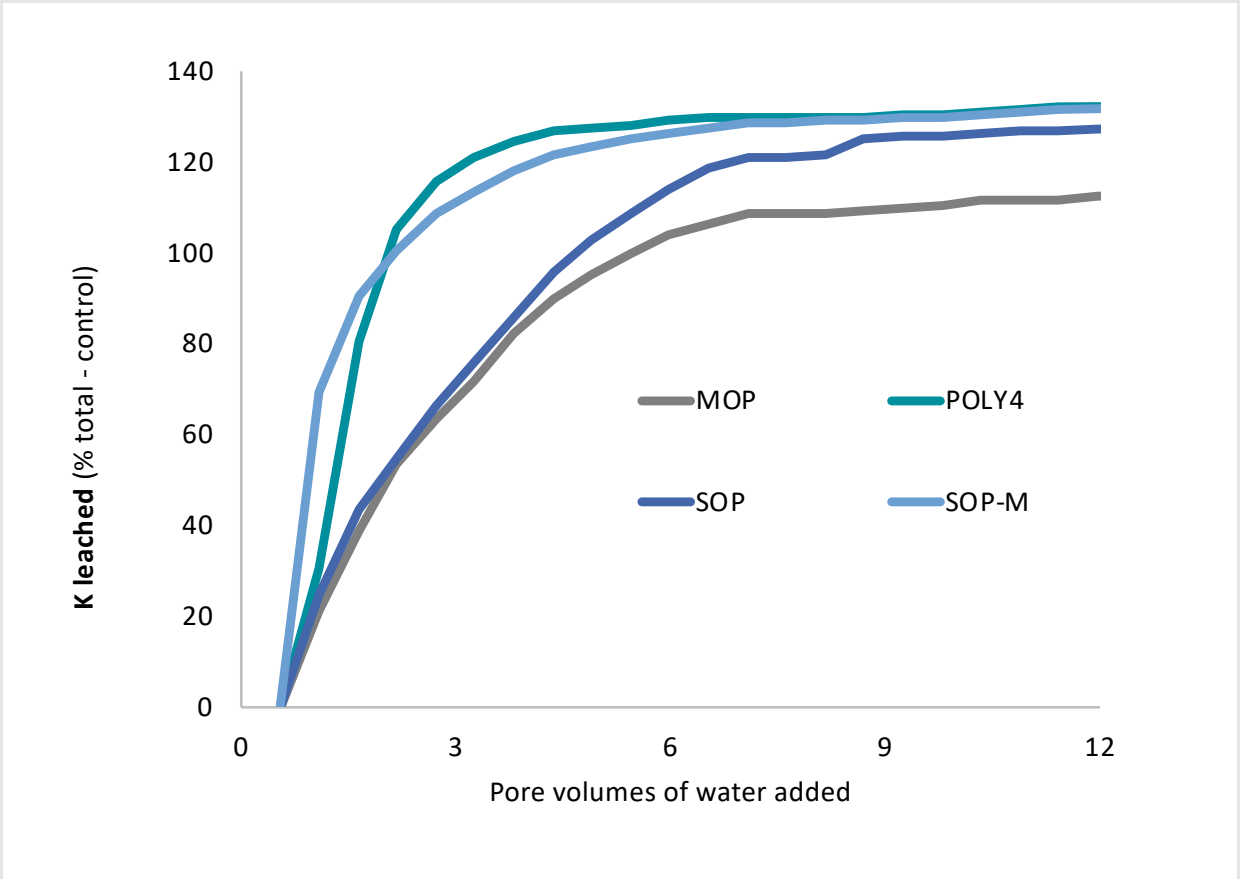
**Fertilizer rate:** 61 $K_2O$ mg column$^{-1}$ (300 $K_2O$ kg ha$^{-1}$). Mixed into the top 10 mm of soil and covered with a filter paper.

**Water applied:** Water drip fed onto the column filter paper at a rate that emulated two years rainfall (117 mL every three days x 24 events) in Florida (Mean annual rainfall:1385 mm)

Columns were maintained at 21 $\pm$ 1 °C (70 $\pm$ 34°F).

# POTASSIUM AVAILABILITY

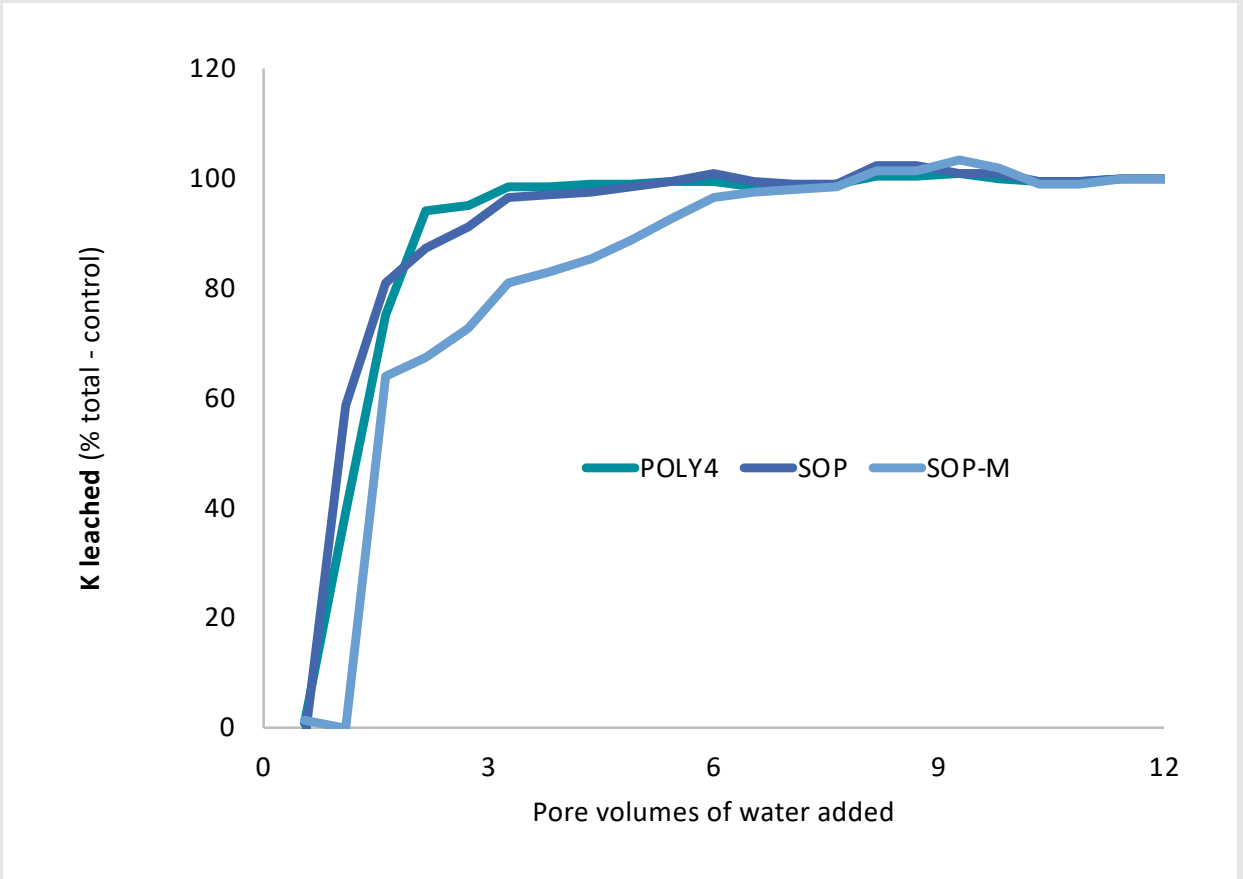
- Over 100% of K added as POLY4 was leached over 24 leaching events




Source: 1000-UOF-1024-14.

# SULPHUR AVAILABILITY

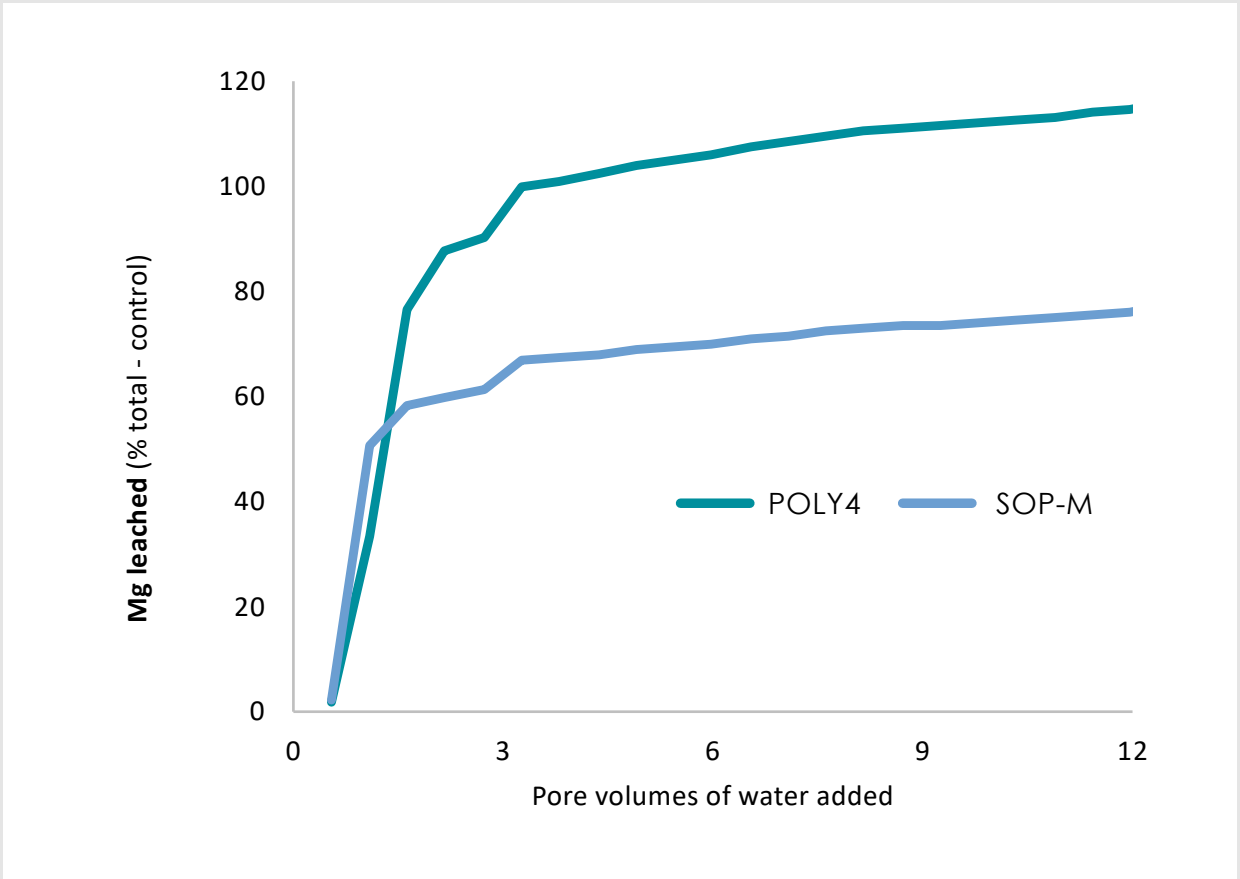
- All of the S supplied by POLY4 was leached




Source: 1000-UOF-1024-14.

# MAGNESIUM AVAILABILITY

- Over 100% of Mg added as POLY4 was leached over 24 leaching events
- Only 75% of Mg added as SOP-M was leached




Source: 1000-UOF-1024-14

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# SOYBEAN NUTRITION

## Potassium

Increases pods per plant and seed weight.

## Sulphur

Improves thousand grain weight and protein content.

## Magnesium

Many critical physiological and biochemical processes in plants are adversely affected by Mg deficiency, leading to impairments in growth and yield.

## Calcium

Soybean deficient in Ca can have reduced leaf expansion, brown spots on young leaves, and can cause premature leaf senescence.

# POTASSIUM AND MAGNESIUM FROM POLY4

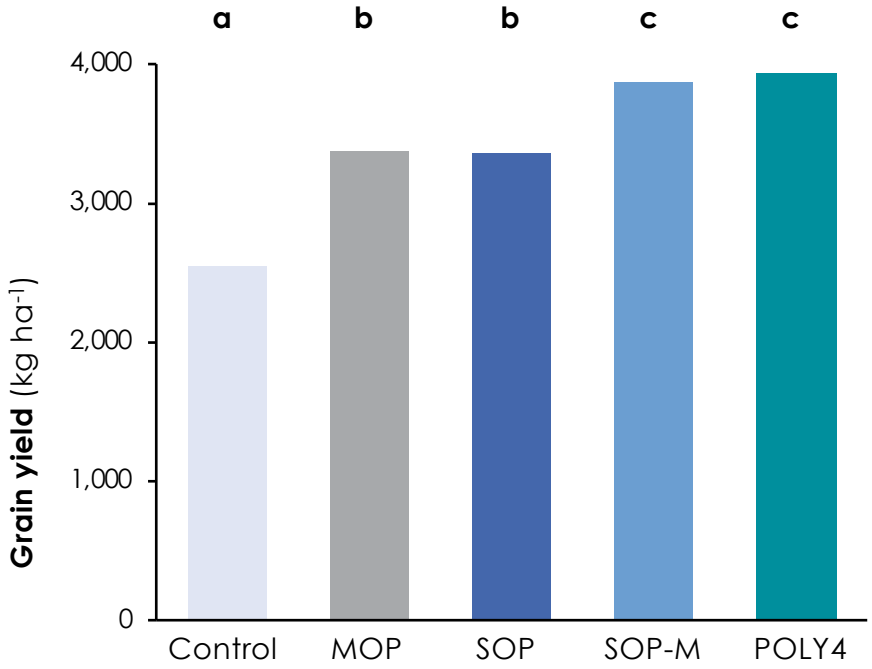
- Study conducted at Weslaco, TX in partnership with Texas A&M
- The use of POLY4 was compared with the use of MOP, SOP and SOP-M at various $K_2O$ rates from 50 – 250 kg $ha^{-1}$ (average 138 kg $ha^{-1}$)
- Soils were predominately calcareous with a sandy clay loam texture[2]
- Soybean variety used was Vernal 36

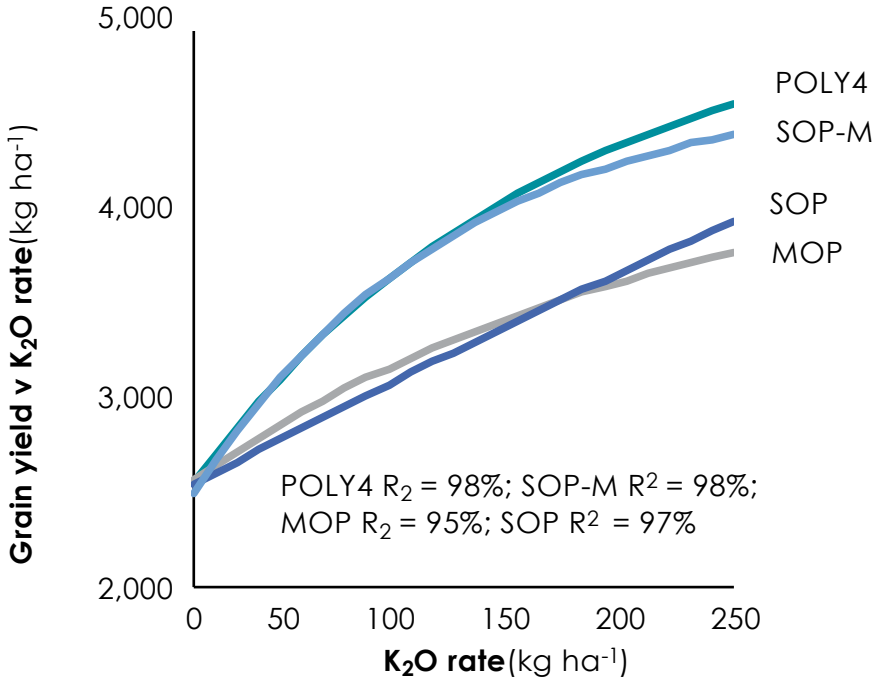
| Treatment[1] | | | | |
|---|---|---|---|---|
| | $K_2O$ | S | CaO | MgO |
| N + P (control) | 0 | 0 | 0 | 0 |
| MOP | 138 | 0 | 0 | 0 |
| SOP | 138 | 47 | 0 | 0 |
| SOP-M | 138 | 138 | 0 | 25 |
| POLY4 | 138 | 187 | 167 | 59 |

Notes: 1)Values are averaged across the $K_2O$ rates of 50, 100, 150 and 250 kg $ha^{-1}$. All plots received 35 kg $ha^{-1}$ of nitrogen and 45 kg $ha^{-1}$ of $P_2O_5$, 2) Initial soil analysis: pH 7.4; 19 mg P $kg^{-1}$, 242 mg K $kg^{-1}$, 177 mg S $kg^{-1}$, 213 mg Mg $kg^{-1}$, 1029 mg Ca $kg^{-1}$.
Sources: Texas A&M (2014) 0000-TAM-0027-14

# GRAIN YIELD

## A) USA – Texas A&M (2014)

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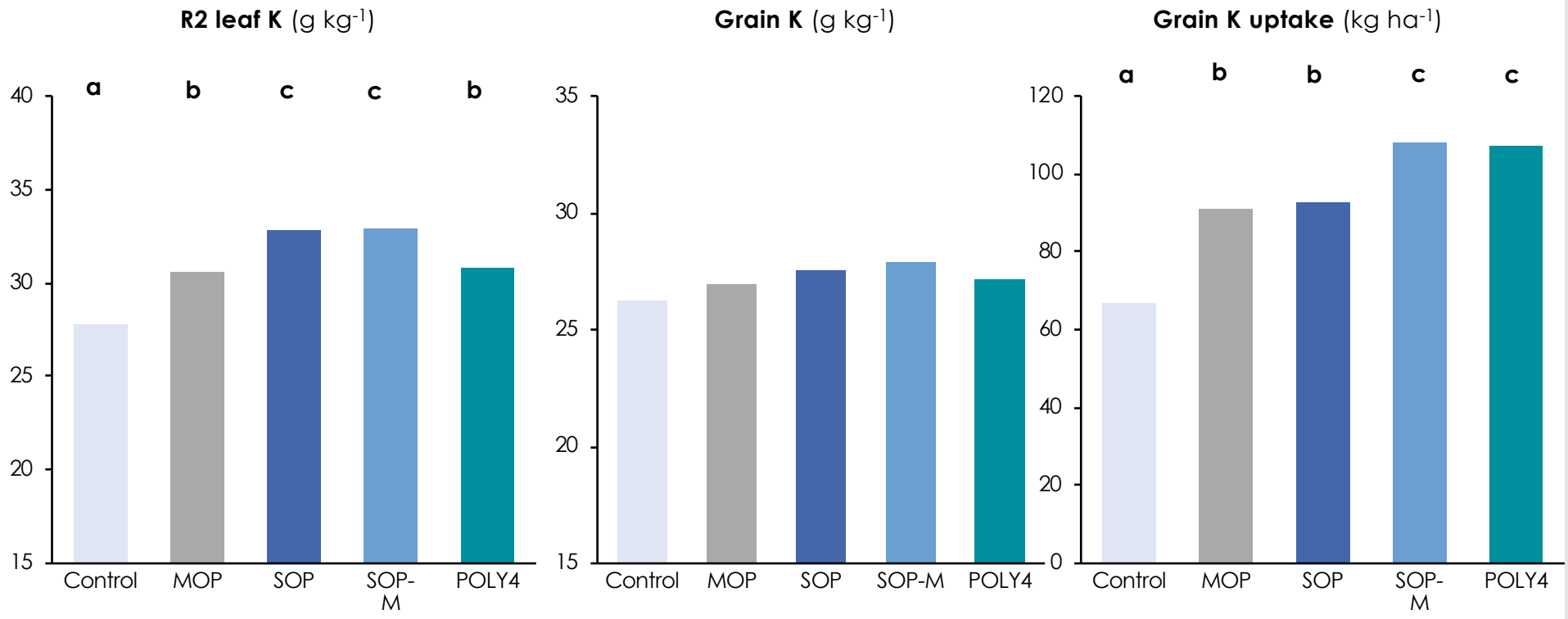
# GRAIN AND LEAF POTASSIUM

## A) USA – Texas A&M (2014)

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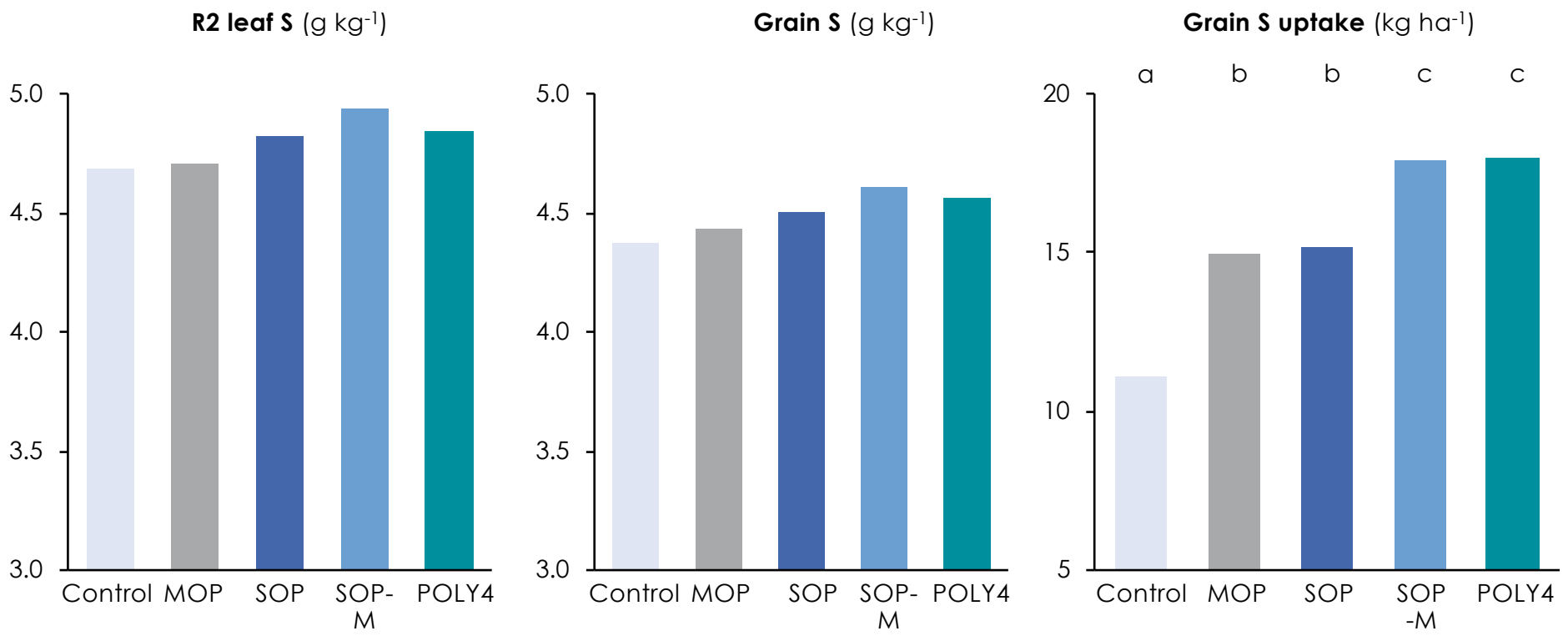
# GRAIN AND LEAF SULPHUR

## A) USA – Texas A&M (2014)

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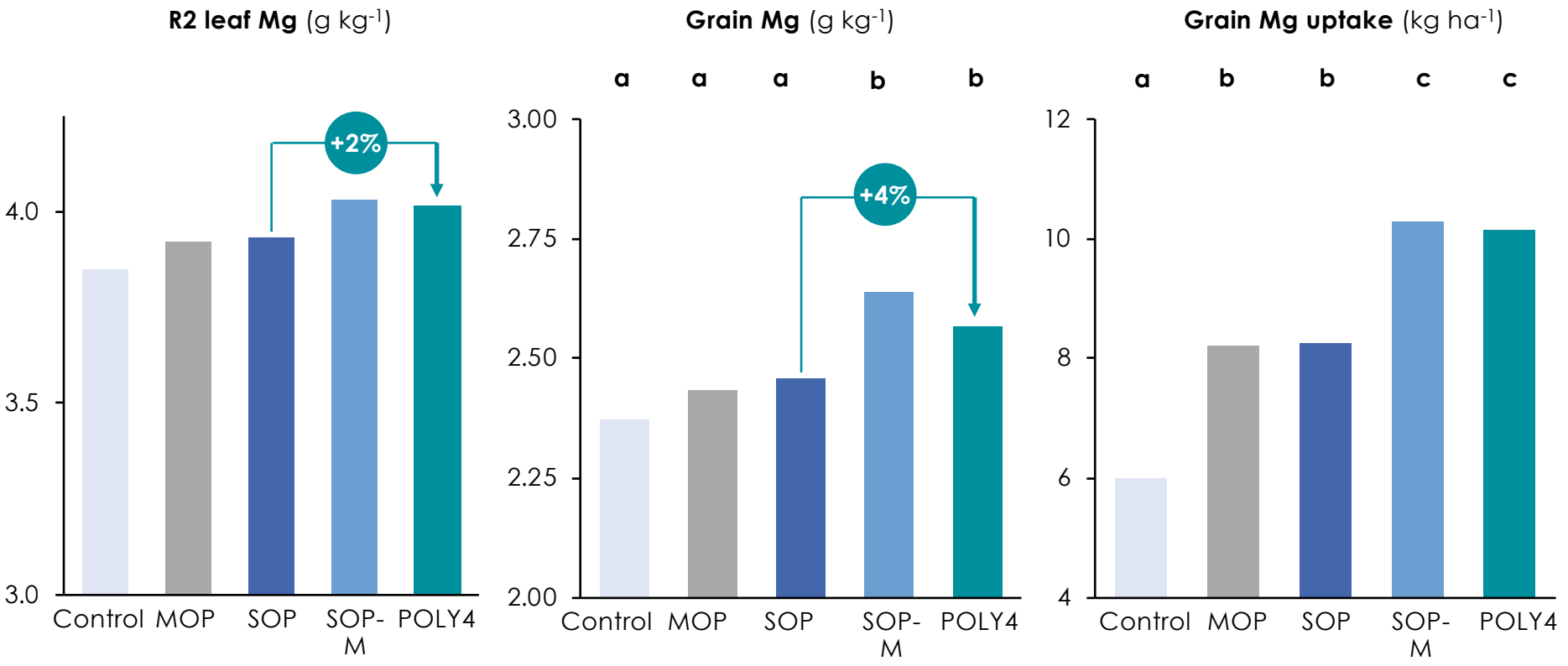
# GRAIN AND LEAF MAGNESIUM

## A) USA – Texas A&M – 2014

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Sources: Texas A&M (2014) 0000-TAM-0027-14

# SULPHUR IN POLY4

- Study conducted at Staples, MN in partnership with University of Minnesota
- The use of MOP + POLY4 was compared with the use of MOP
- The soil was a Verndale sandy loam and the soybean variety was W3080
- Sulphur is not usually recommended in the Midwest, but there is growing recognition and occurrence of S deficiencies

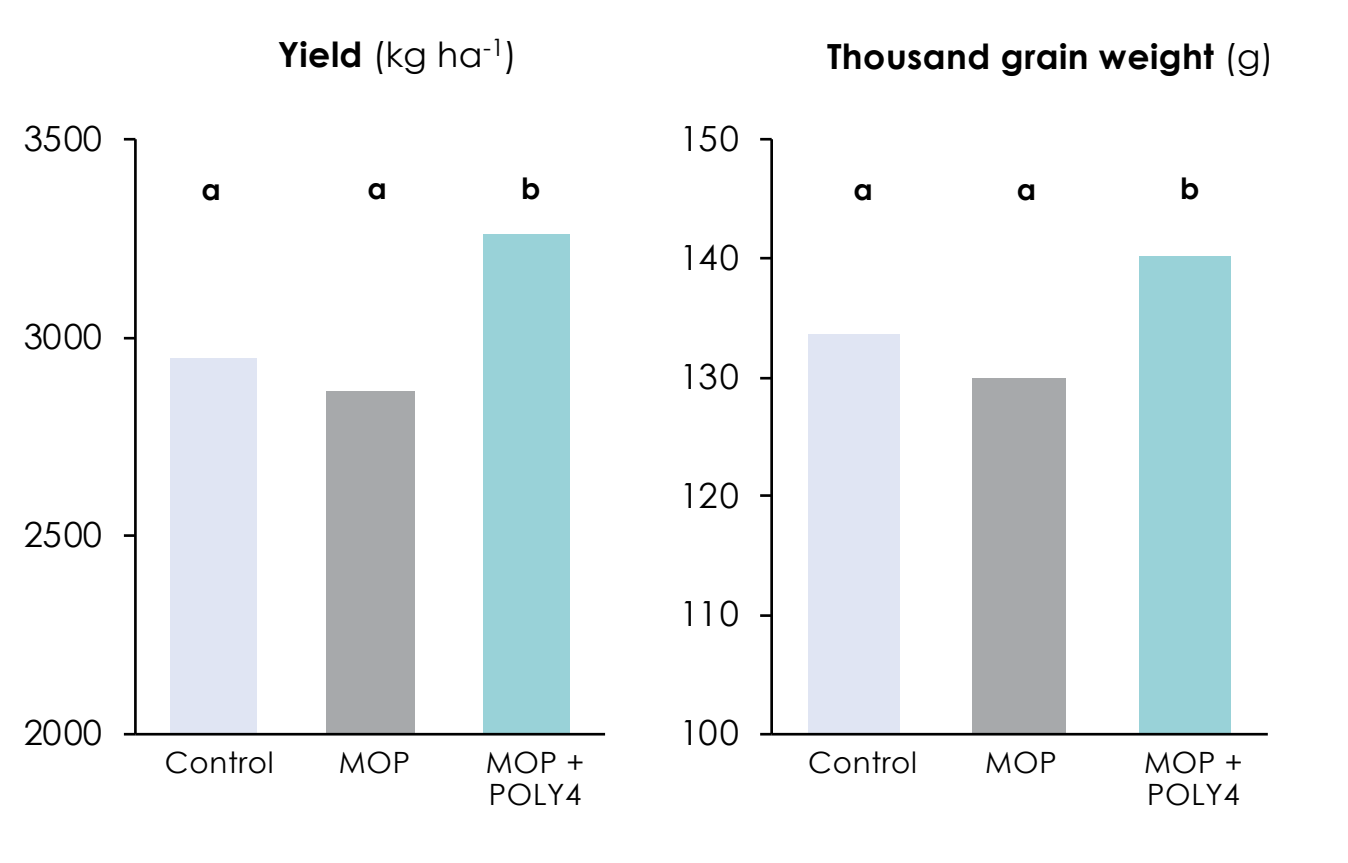
| Treatment[1] | | | | |
|---|---|---|---|---|
| | $K_2O$ | S | CaO | MgO |
| N + P (control) | 0 | 0 | 0 | 0 |
| MOP | 67 | 0 | 0 | 0 |
| MOP + POLY4 | 67 | 23 | 21 | 7 |

Notes: 1)All plots received 23.4 kg N $ha^{-1}$ and 60 kg $P_2O_5$ $ha^{-1}$; 2) Initial soil analysis: pre-trial pH 7.50, pre-trial P (21 mg $kg^{-1}$), pre-trial K (237 mg $kg^{-1}$), pre-trial S (6.9 mg $kg^{-1}$), pre-trial Mg (239 mg $kg^{-1}$), pre-trial Ca (5,536 mg $kg^{-1}$).
Source: University of Minnesota (2017) 14000-UMN-14018-17.

# YIELD

## USA – Staples UMN 17

- This site was not K responsive ($P > 0.1$)
- Grain yield was increased ($P = 0.004$) in S-treated plots
- Thousand grain weight was also increased with S application ($P < 0.001$)

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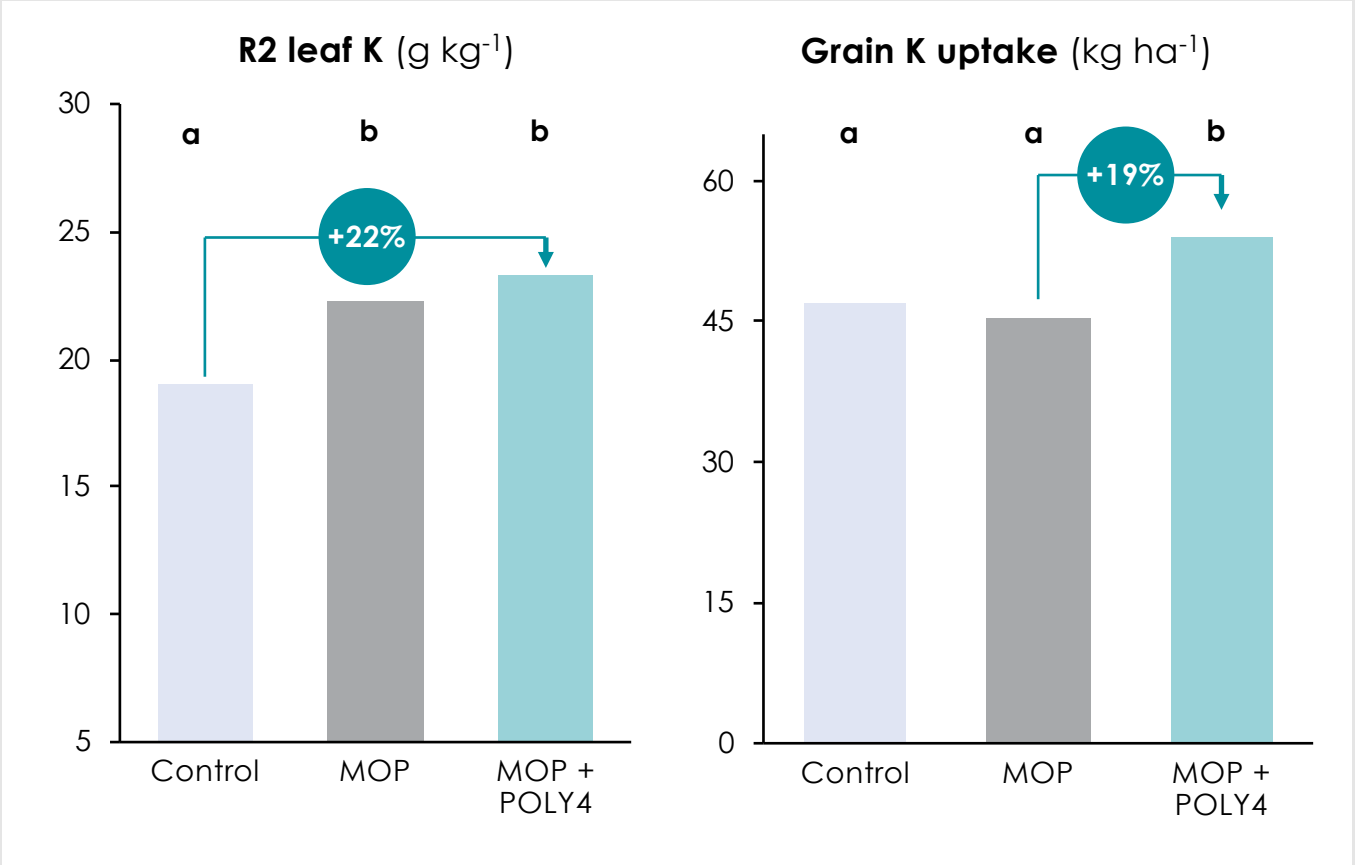
# LEAF AND GRAIN POTASSIUM

## A) USA – Staples UMN 17

- Potassium fertilizer increased ($P < 0.001$) R2 leaf K.
- K did not affect grain K content ($P = 0.670$).
- Grain K uptake was greater in the MOP+POLY4 treated plots ($P = 0.012$) as they produced a greater yield.

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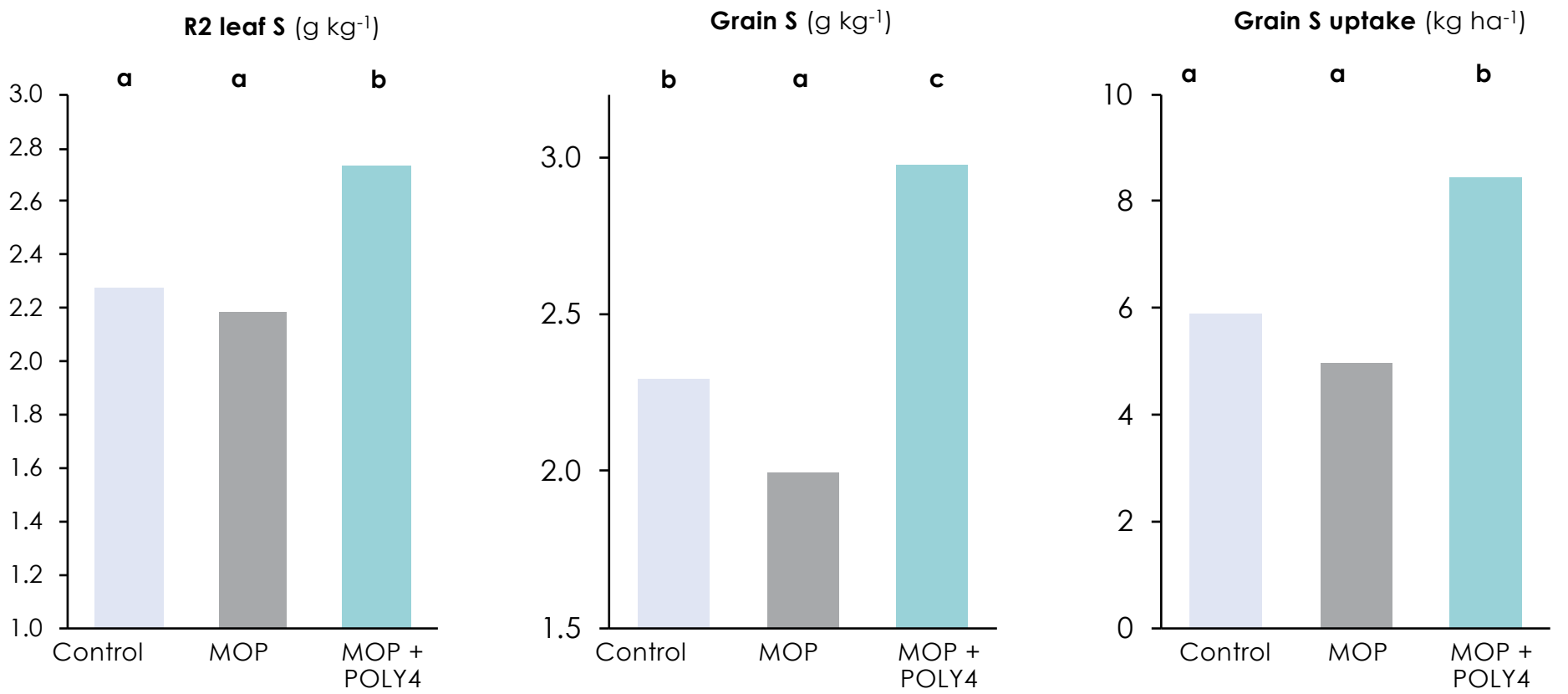
# LEAF AND GRAIN SULPHUR

## A) USA – Staples UMN 17

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Source: University of Minnesota (2017) 14000-UMN-14018-17.

# SUMMARY

- POLY4 is a multi-nutrient fertilizer containing 14% $K_2O$, 17% CaO, 6% MgO and 19% S
- Leaching column studies indicated higher and quicker accumulated K in leachate from POLY4 treatment than other K treatments in sandy loam soils
- **Evidence for availability and response from K, Mg, and S was obtained in soybeans highlighting the value of multi-nutrient POLY4 in these systems**

# ACKNOWLEDGEMENTS

**Sirius Minerals thanks those involved in our POLY4 research**

| Institute | Research Partners |
|---|---|
| Texas A&M | Dr. John Jifon |
| University of Minnesota | Dr. Daniel Kaiser |
| University of Florida | Dr. Marcel Barbier and Dr. Yuncong Li |

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# THANK YOU

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