

# EVALUATION OF POLYHALITE-BASED POLY4 FOR ENHANCING CORN AND WHEAT PRODUCTIVITY IN INDIA

Dr VK Singh<sup>1</sup>, Neeraj Awasthi<sup>2</sup>, Rachel Fields<sup>2</sup>, Ross Mitchell<sup>2</sup>  
1) ICAR-IARI, New Delhi-12; 2) Sirius Minerals, Scarborough, United Kingdom

## Abstract

A multi-nutrient fertilizer POLY4 (produced from polyhalite, a mineral containing potassium (K), sulphur (S), magnesium (Mg) and calcium (Ca)) was evaluated for corn and wheat production at the Indian Agricultural Research Institute in New Delhi.

POLY4, in addition to standard application of N and P, resulted in a significantly higher grain yield of corn (7.8 t ha<sup>-1</sup>) and wheat (5.0 t ha<sup>-1</sup>) than N + P or NP + MOP. Yields were also numerically greater than MOP + elemental S. Furthermore, the yield components of both crops were improved after including POLY4 in the fertilizer programme.

## Introduction

- Corn and wheat are typically grown in rotation each year in Northern India.
- Many farmers apply only N + P in these systems, even though application of K and S is recommended.
- Historically, K has rarely been considered a limiting factor to crop production in this region. But continuous soil K depletion without fertilizer addition has increased the occurrence of K deficiency.<sup>1</sup>
- S is also an important limiting nutrient, but when applied is usually as elemental S.

| Treatments      | Nutrient application rate (kg ha <sup>-1</sup> ) |     |     |     |
|-----------------|--------------------------------------------------|-----|-----|-----|
|                 | K <sub>2</sub> O                                 | S   | CaO | MgO |
| N + P (control) | 0                                                | 0   | 0   | 0   |
| MOP             | 38                                               | 0   | 0   | 0   |
| MOP             | 75                                               | 0   | 0   | 0   |
| MOP + S         | 38                                               | 51  | 0   | 0   |
| MOP + S         | 75                                               | 102 | 0   | 0   |
| POLY4           | 38                                               | 51  | 46  | 16  |
| POLY4           | 75                                               | 102 | 91  | 32  |

| Treatments      | Nutrient application rate (kg ha <sup>-1</sup> ) |    |     |     |
|-----------------|--------------------------------------------------|----|-----|-----|
|                 | K <sub>2</sub> O                                 | S  | CaO | MgO |
| N + P (control) | 0                                                | 0  | 0   | 0   |
| MOP             | 30                                               | 0  | 0   | 0   |
| MOP             | 60                                               | 0  | 0   | 0   |
| MOP + S         | 30                                               | 41 | 0   | 0   |
| MOP + S         | 60                                               | 81 | 0   | 0   |
| POLY4           | 30                                               | 41 | 36  | 13  |
| POLY4           | 60                                               | 81 | 73  | 26  |

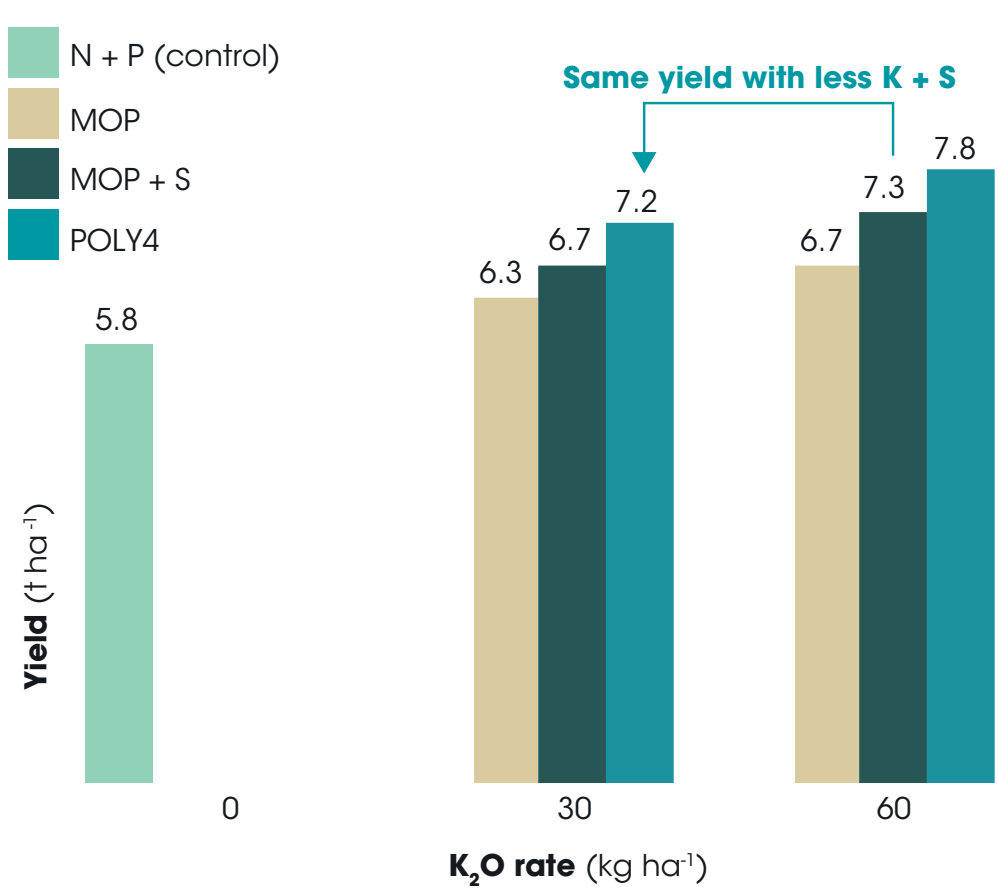
## Methodology

- The aim of these trials was to evaluate the use of POLY4 at the recommended and below recommended rates compared to MOP and MOP + S.
- Treatments arranged in a randomised complete block design.
- All corn treatments received 150 kg N ha<sup>-1</sup> and 75 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>.
- All wheat treatments received 120 kg N ha<sup>-1</sup> and 60 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup>.
- Initial soil analysis: pH: 8.1, 3% organic carbon, 113 mg N kg<sup>-1</sup>, 9 mg P<sub>2</sub>O<sub>5</sub> kg<sup>-1</sup>, 101 mg K<sub>2</sub>O kg<sup>-1</sup>, 1.4 mg S kg<sup>-1</sup>.
- Genstat ANOVA used to analyse data. Means separated by Fisher's LSD test at p < 0.1.

## Corn results

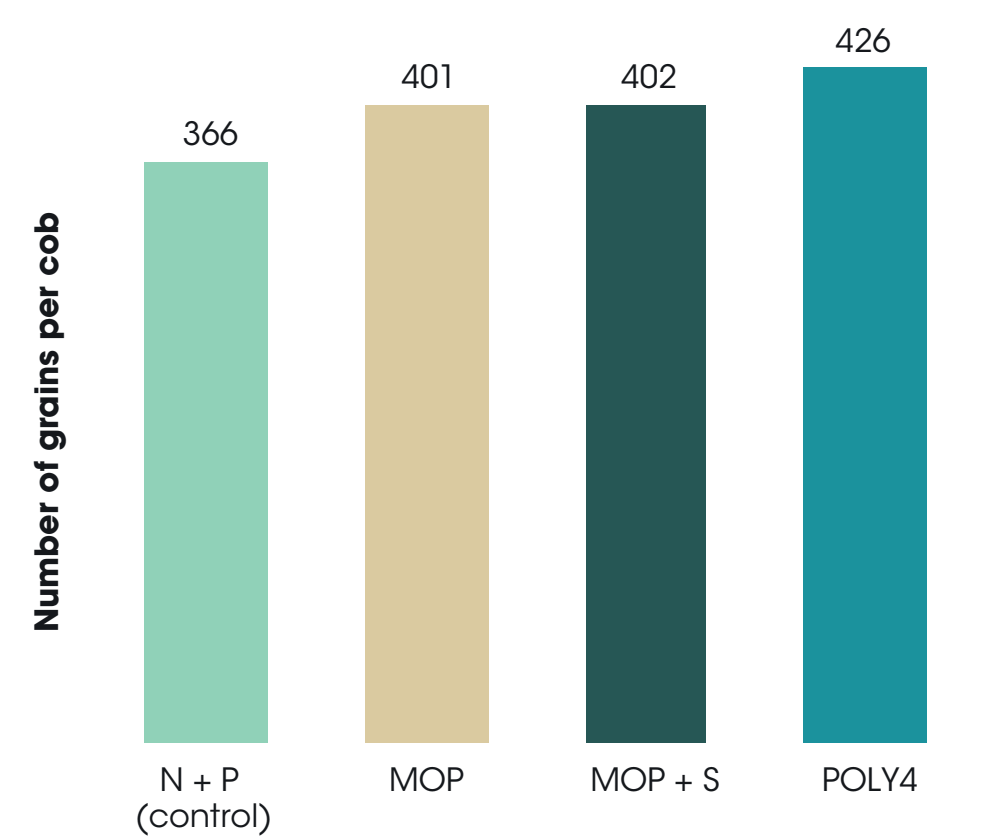
### Yield performance

- Average yield of corn fertilized with POLY4 was 7.5 t ha<sup>-1</sup>.
- This was significantly greater than with MOP + S (7.0 t ha<sup>-1</sup>), MOP (6.5 t ha<sup>-1</sup>) and N + P (5.8 t ha<sup>-1</sup>).
- The lower application rate of POLY4 gave a comparable yield (7.2 t ha<sup>-1</sup>) to the higher application rate of MOP + S (7.3 t ha<sup>-1</sup>).



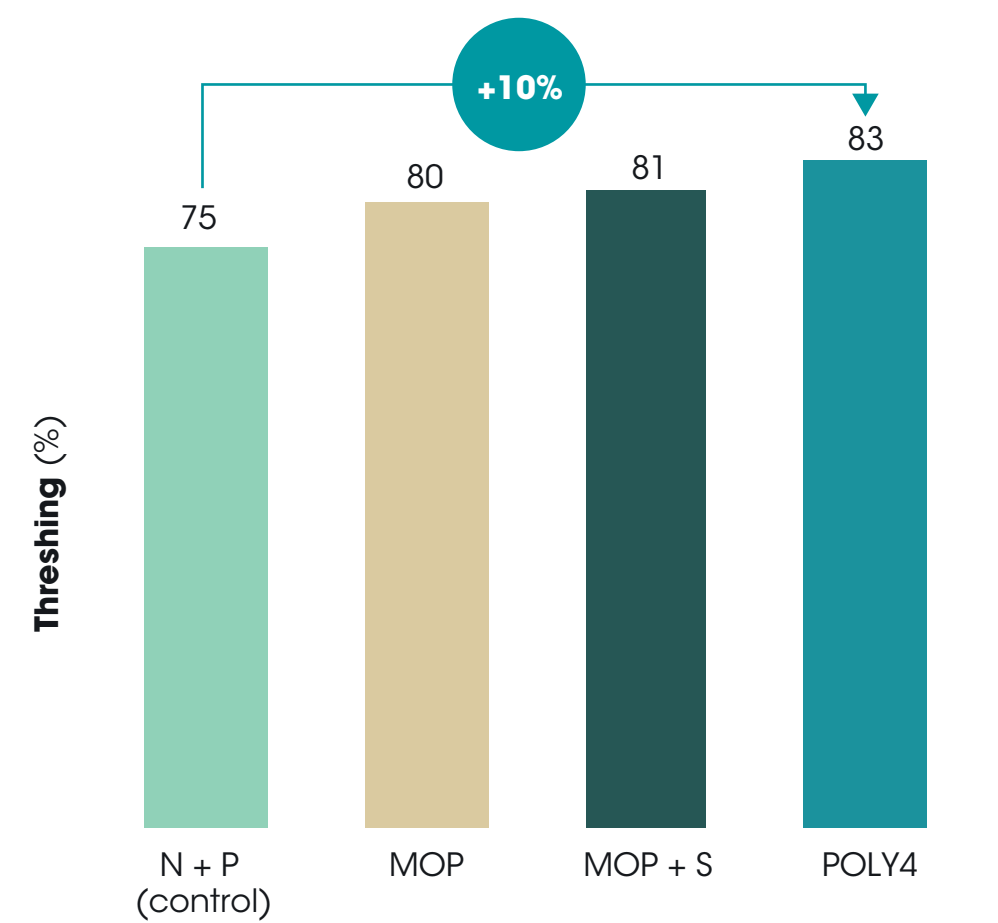
### Yield components

- POLY4-fertilized corn had significantly more grains per cob than other treatments.
- Fertilizer treatments did not affect thousand grain weight.



### Processability

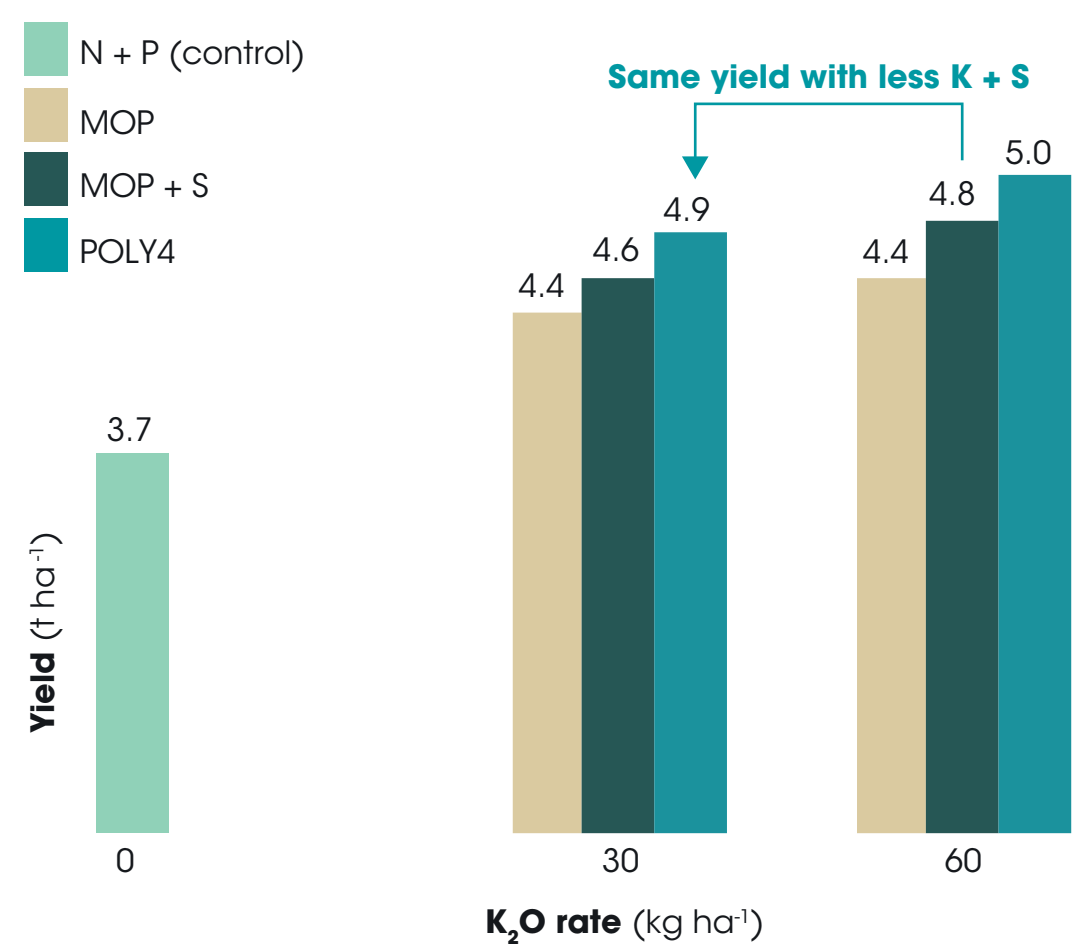
- Threshing percentage is the proportion of grain removed from the cob during processing. A higher threshing percent is likely to follow factors like better cob maturity.
- All treatments significantly increased threshing (%) compared to N + P.



## Wheat results

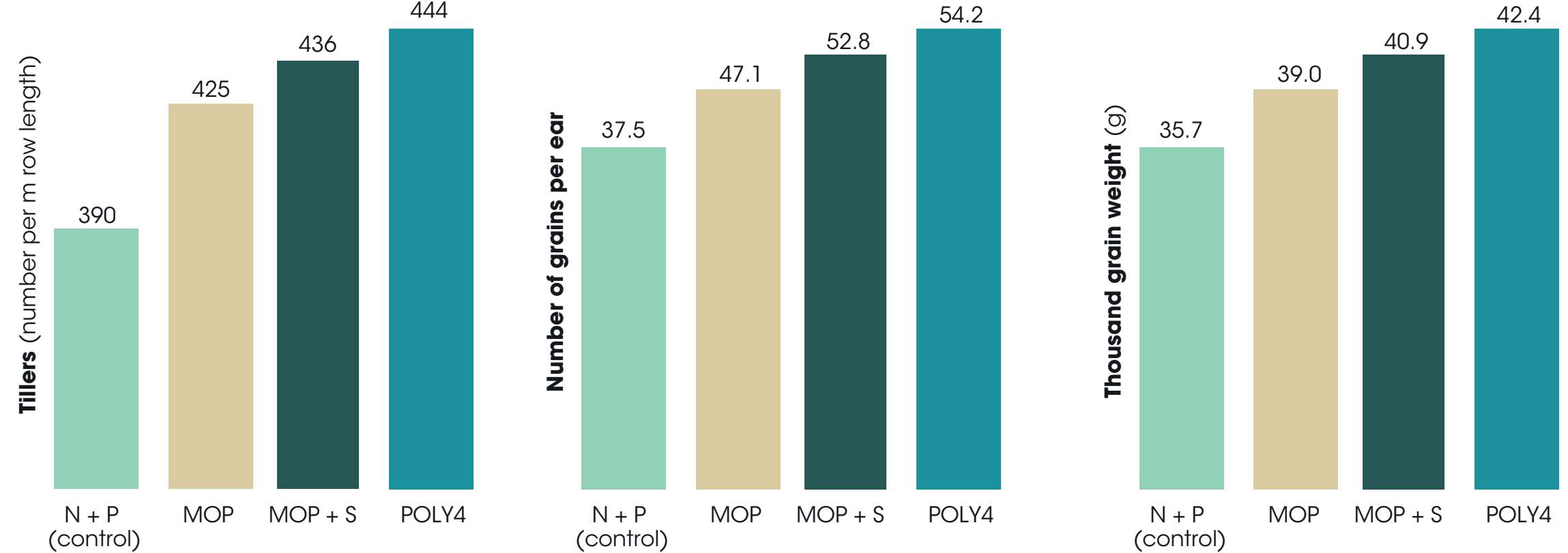
### Yield performance

- POLY4-fertilized wheat had the best average yield (4.9 t ha<sup>-1</sup>).
- This was significantly higher than MOP (4.4 t ha<sup>-1</sup>) and N + P (control) (3.7 t ha<sup>-1</sup>).
- The yield of MOP + S fertilized crop was intermediate (4.7 t ha<sup>-1</sup>) but consistently lower than the POLY4 crops.
- The lower application rate of POLY4 (30 kg K<sub>2</sub>O ha<sup>-1</sup> and 40 kg S ha<sup>-1</sup>) produced a similar yield to the higher rate of MOP + S (60 kg K<sub>2</sub>O ha<sup>-1</sup> and 80 kg S ha<sup>-1</sup> from MOP + S).



### Yield components

- POLY4-fertilized wheat had a significantly greater number of tillers and more grains per ear than MOP or N + P.
- The MOP + S again gave intermediate results.
- POLY4-fertilized wheat also had significantly greater thousand grain weight than wheat fertilized with MOP.



## Conclusions

- POLY4 improved yield and yield components for both corn and wheat.
- Adding MOP-K and S each improved crop yields, but neither could match the yield benefit from POLY4.
- Many farmers in India apply only N + P fertilizer and this may be restricting their yields. Based on these results, a farmer could supply half the recommended K and S rates from POLY4 and achieve comparable yields to crops supplied with the full K and S applications from MOP + S.

## Notes

1) Bijay-Singh et al (2003); Singh, V.K., Dwivedi, B.S., Tiwari, K.N., Majumdar, K., Rani, M., Sing, S.K., Timsina, J. (2014) Optimizing nutrient management strategies for rice-wheat system in the Indo-Gangetic Plains of India and adjacent region for higher productivity, nutrient use efficiency and profits. Field Crops Research. 164. pp 30-44; Singh, B., Singh, Y-S, Imas, P., Jian-chang, X. (2003). Potassium Nutrition of the Rice- Wheat Cropping System. Advances in Agronomy. 81. 203-259.

Source: 67000-ICAR-67011-17, ICAR-IARI, New Delhi (2018).

Follow us on social media

