

TRIAL RESULTS

MUSTARD

PANTNAGAR (UTTARAKHAND), INDIA (2018)

HIGHLIGHTS

In NPK+S balanced fertilizer plans mustard seed yield was increased by an average of 13% compared to MOP + S plans.

Total oil yield was increased by an average of 18% compared to MOP + S plans.

POLY4 fertilizer plans improved oil quality, decreasing erucic acid content by 6% compared to MOP + S plans.

An average 17% protein yield increase was achieved with POLY4 plans.

POLY4 fertilizer plan increased crop margin by up to US\$104/ha.

TRIAL OBJECTIVE

To assess the effect of fertilizing mustard with POLY4 in India.

In 2016-2017 the five leading states for mustard production¹ in India were:

Province	Production (Mmt)
Rajasthan	3.3
Haryana	0.8
Madhya Pradesh	0.7
Uttar Pradesh	0.6
West Bengal	0.5

OVERVIEW

PARTNER: G. B. Pant University of Agriculture and Technology

LOCATION: Pantnagar Uttarakhand, India

YEAR: 2018

- In India, during 2016-2017, 6.8 Million metric tonnes (Mmt) of mustard was harvested from 5.7 million hectares.¹
- The trial was conducted in Norman Borlaug Crop Research Centre of GBPUA&T Pantnagar, Uttarakhand. This is in Uttar Pradesh, which ranks fourth in Indian mustard production.
- A locally-typical mustard variety was used (NRC-HB-101).
- The performance of POLY4 was tested against the recommended application rates of K_2O and/or S supplied by locally-typical K and S fertilizers (MOP and elemental sulphur in bentonite). An MOP + POLY4 mixture was also used and compared to equivalent K and S inputs (MOP + 40S).



TREATMENT TABLE^{3,4}

Treatment	Nutrients applied (kg ha ⁻¹)						
	N	P ₂ O ₅	K ₂ O	MgO	CaO	S	Cl ⁻
N + P (control)	120	40	0	0	0	0	0
MOP	120	40	44	0	0	0	35
MOP + 40S	120	40	44	0	0	40	35
MOP + POLY4	120	40	44	13	36	40	18
MOP + 60S	120	40	44	0	0	60	35
POLY4	120	40	44	19	53	60	9

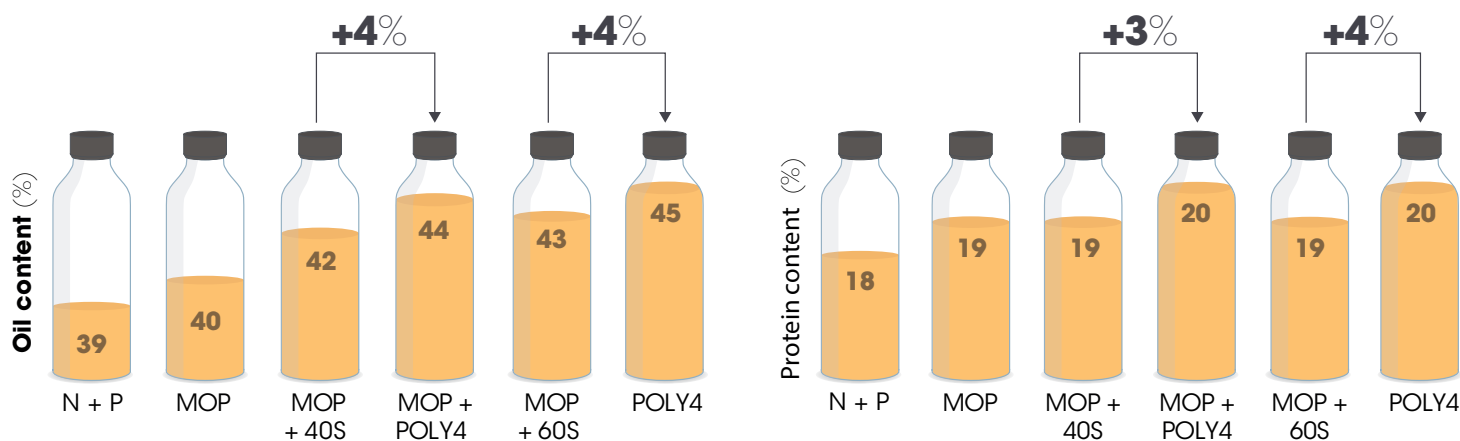
SEED YIELD AND QUALITY^{2,3,4}

- The POLY4 and MOP + POLY4 treatments had the greatest yields.
- POLY4 treatment yielded 13% more than both MOP + 40S and MOP + 60S.



OIL AND PROTEIN CONTENT^{2,3,4}

- The POLY4 and POLY4 + MOP had higher total oil and protein content than the MOP + 40S and MOP + 60S.



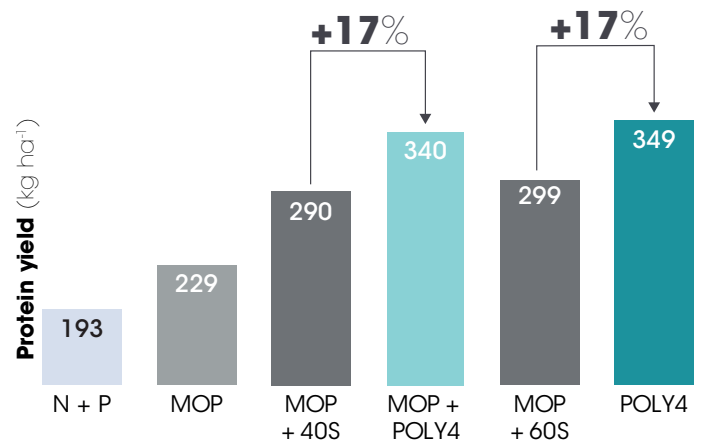
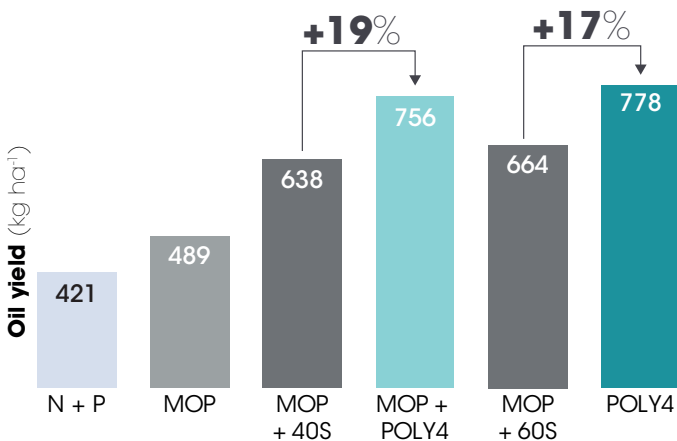
OIL COMPOSITION^{2,3,4}

- The glucosinolate and other fatty acid contents of mustard seeds are important quality parameters. Low levels of glucosinolate and erucic acid are desired.
- The POLY4 and MOP + POLY4 treatments had 6% less erucic acid than the MOP + 40S and MOP + 60S.
- Linolenic, oleic and palmitic acids are beneficial for human health.
- POLY4 and POLY4 + MOP treatments had 6% more linolenic acid than their MOP + S equivalents.
- The palmitic acid content of the POLY4-treated mustard was 18% greater than the MOP + 60S treatments.



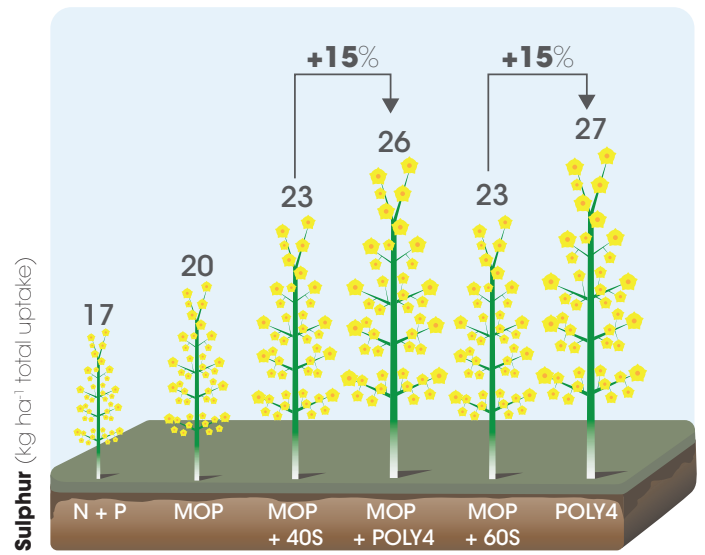
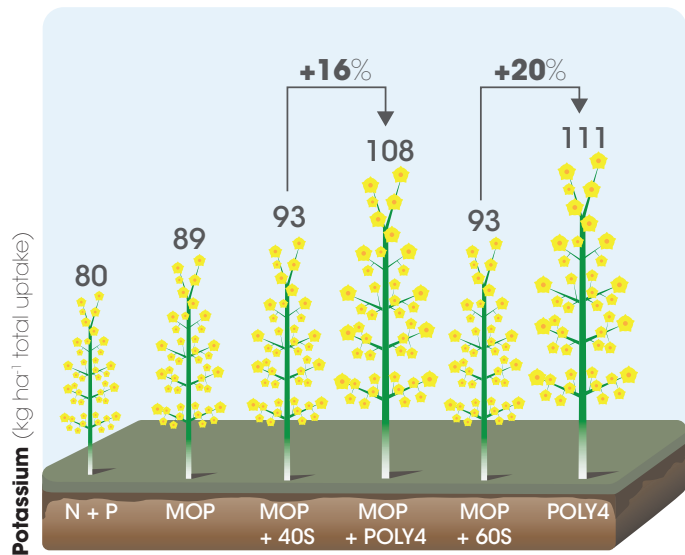
Mustard compounds	Treatment					
	N + P (control)	MOP	MOP + 40S	MOP + POLY4	MOP + 60S	POLY4
Erucic acid (%)	46.1	47.9	49.8	46.7	47.9	45.1
Glucosinolate ($\mu\text{mol kg}^{-1}$)	0.10	0.11	0.10	0.11	0.10	0.11
Linolenic acid (%)	11.0	11.2	12.8	13.5	13.0	13.9
Oleic acid (%)	12.7	12.6	12.4	12.4	13.1	13
Palmitic acid (%)	3.27	3.17	3.27	3.30	3.20	3.77

OIL AND PROTEIN YIELDS

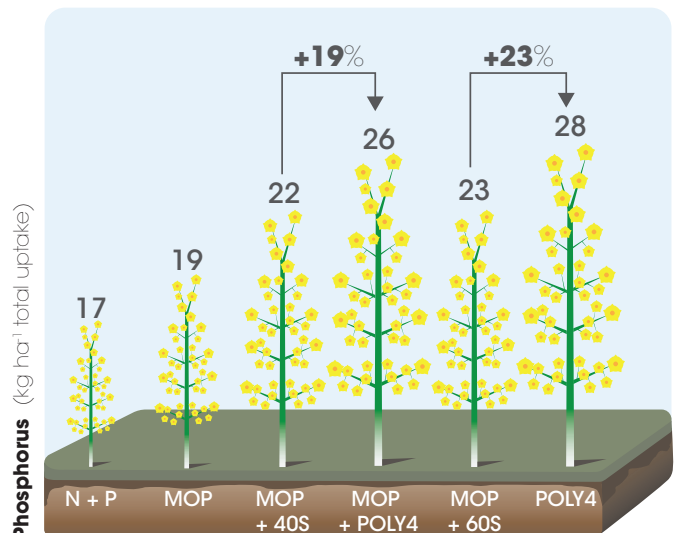
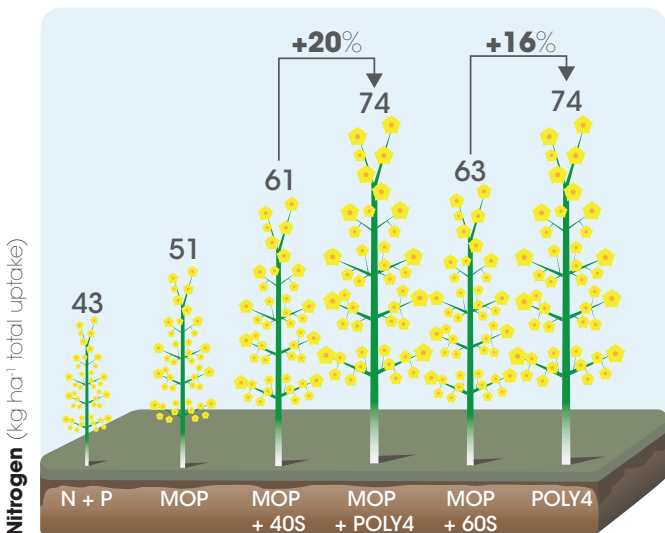
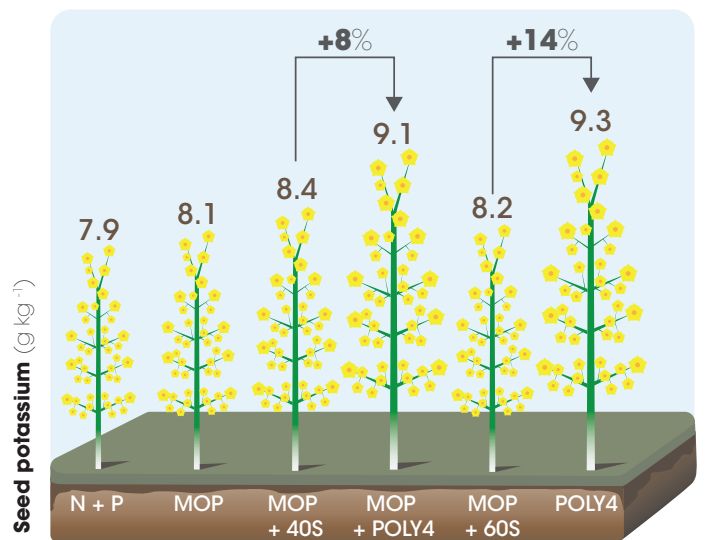


- The oil yields of the POLY4 and MOP + POLY4 fertilized mustard were increased by 17 and 19% compared to both MOP + 40S and MOP + 60S treatments.
- Mustard protein yields were increased by 17% compared to the MOP + S treatments.

NUTRIENT UPTAKE AT HARVEST^{2,3,4}



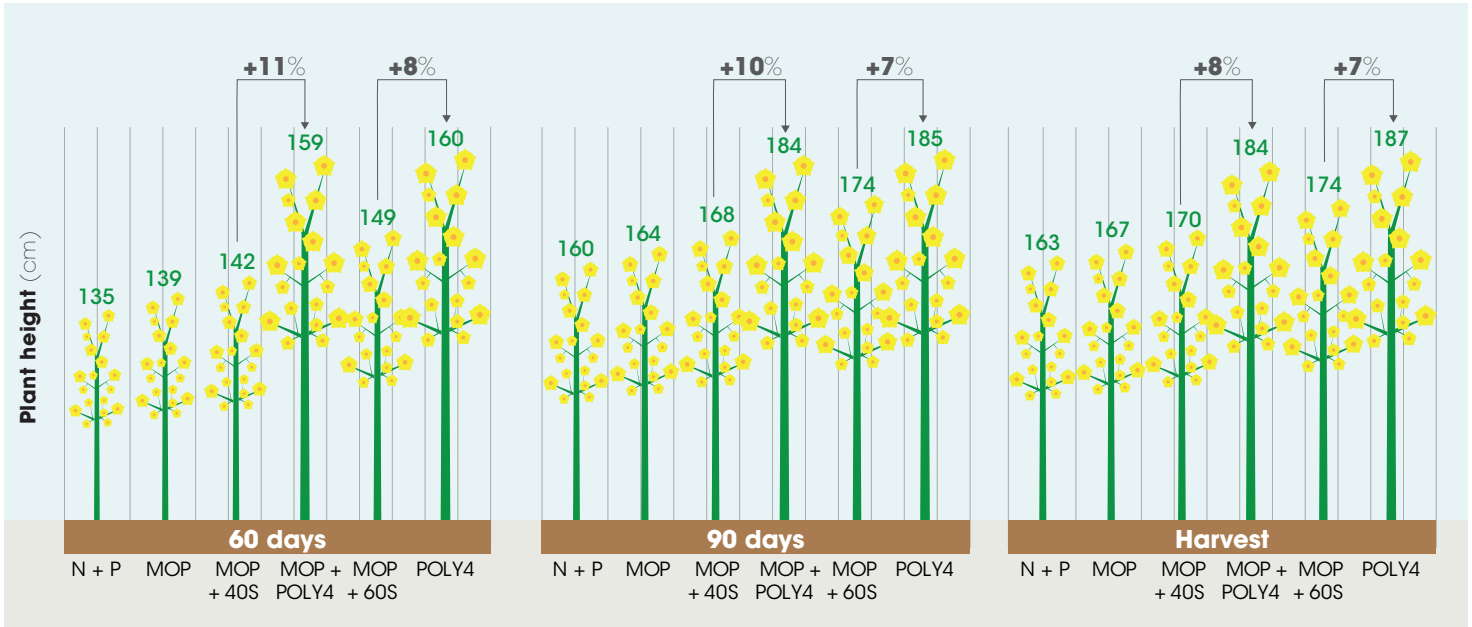
- POLY4 increased the seed K concentration by a significant 14% compared to the MOP + 60S.
- The POLY4 and MOP + POLY4 also significantly increased total crop uptake of K by an average of 18% and of S by 15% compared to MOP + S plans.



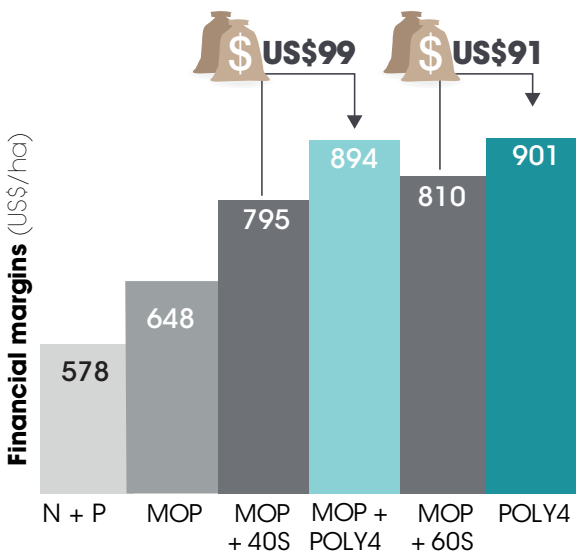
- The N uptake of the POLY4 and MOP + POLY4 mustard plant was an average of 18% greater than the MOP + S treatments.

- The P uptake of the POLY4 and MOP + POLY4 was higher by an average of 21% compared to the MOP + S treatments.

CROP HEIGHT^{2,3,4}



FINANCIAL ANALYSIS⁴



- The maximum financial margins were achieved by the MOP + POLY4 (US\$894/ha) and POLY4 (US\$901/ha) fertilizer treatments.
- The MOP + POLY4 and POLY4 treatments increased financial margins by US\$99/ha and US\$91 compared to the MOP + S fertilizer plans.

Notes: 1) Crop and Production Statistics, Ministry of Agriculture & Farmers Welfare, India, (2017); 2) Treatment table is based on the recommended K₂O rate of 44 kg K₂O ha⁻¹. MOP + S contained 40 or 60 kg elemental sulphur with bentonite; All treatments received 120 kg N ha⁻¹; 40 kg P ha⁻¹; and 44 kg K₂O ha⁻¹ from MOP and/or POLY4. MOP + POLY4 was used in a K₂O ratio of 66:34. POLY4 = 3% Cl⁻, and MOP = 48% Cl⁻; Initial soil analysis: pH 7.5; 7 mg P kg⁻¹, 72 mg K kg⁻¹, 2705 mg Ca kg⁻¹, 292 mg Mg kg⁻¹; and 5 mg S kg⁻¹; 3) Results presented are based on data from GENSTAT ANOVA analysis; 4) Fertilizer prices based on local prices: urea (US\$84/t), DAP (US\$307/t), MOP (US\$214/t), POLY4 (US\$200/t), bentonite (US\$350/t). Analysis accounts for fertilizer application of spreading cost of US\$9.10/t. Mustard price was US\$580/t. Margin = crop output (US\$/ha) minus (cost of fertilizer material plus spreading cost).

Source: G. B. Pant University of Agriculture and Technology (2018) 88000-GBPU-88010-17

siriusminerals.com | +44 1723 470 010 | commercial@siriusminerals.com

Registered Address: 3rd Floor Greener House, 66-68 Haymarket, London SW1Y 4RF, UK

Company Registered Number: 4948435

