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EFFECT OF DIFFERENT BLEND RATIOS OF POLY4 WITH MOP ON THE YIELD AND NUTRIENT UPTAKE OF RICE IN SICHUAN, CHINA

ASA & CSSA Annual Meeting 2018

Enhancing productivity in a changing climate

Presentation by Xiaohui Fan

6 November 2018

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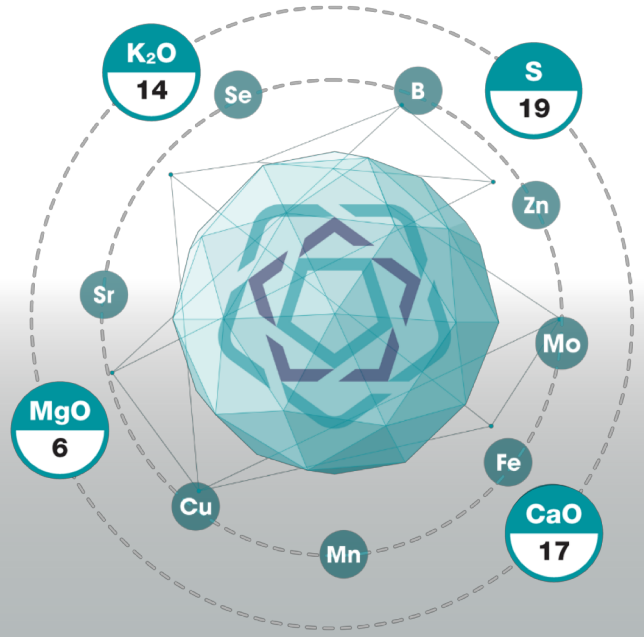
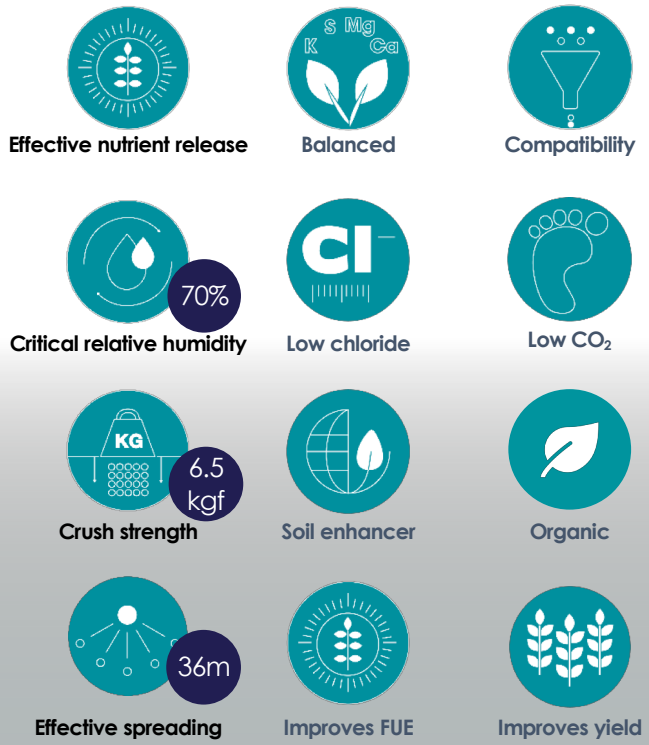
INTRODUCTION TO POLY4 – POLYHALITE-BASED FERTILIZER
($K_2SO_4.MgSO_4.2CaSO_4.2H_2O$)

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.

CONTEXT

- China is the largest rice producer in the world, and accounts for as much as 29% of total world rice production. China produced 209.5 million metric tonnes of rice from 30.2 million ha of land in 2016 (FAO, 2016)
- Rice is a significant crop in Sichuan province in China
- The rice cultivated area in Sichuan province was 1.99 million hectares
- Large amounts of potassium are required for rice growing

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CHINESE RICE FARMERS COMMONLY USE MOP AS A POTASSIUM FERTILIZER

TRIAL OBJECTIVE

- To assess the effects of different blend ratios of POLY4 with MOP on the yield and nutrient uptake of rice in Sichuan, China

四川省农业科学院
Sichuan Academy of Agricultural Sciences

Source: 19000-SAAS-19017-17.

SOIL ANALYSIS

- Site location: Maosheng village, Lu County, Sichuan province, China
- The basic properties of the experimental soil

pH	OM (%)	Available P (mg kg^{-1})	Available K (mg kg^{-1})	Exchangeable Ca (mg kg^{-1})	Exchangeable Mg (mg kg^{-1})
5.3	3.9	7.5	136	3400	600

Notes: 1) All treatments received 150 kg N ha^{-1} 75 kg P_2O_5 ha^{-1}.
Source: 19000-SAAS-19017-17.

TREATMENTS

The application rates of nutrients from POLY4 in rice (kg ha^{-1})

Treatment[1]	K_2O (fertilizer)	POLY4 proportion (%)	CaO	MgO	S
Control	0		0	0	0
MOP 100	135	0	0	0	0
MOP 20 + POLY4 80	135	80	129	46	147
MOP 30 + POLY4 70	135	70	113	40	129
MOP 50 + POLY4 50	135	50	80	29	92
MOP 70 + POLY4 30	135	30	48	17	55
POLY4 100	135	100	161	58	184

Notes: 1) All treatments received 150 kg N ha^{-1} 75 kg P_2O_5 ha^{-1}.
Source: 19000-SAAS-19017-17.

MATERIAL AND METHODS (1)

- The nitrogen and phosphorus fertilizer sources were urea and mono-ammonium phosphate respectively
- All P and K fertilizers were applied as base fertilizer
- N fertilizer was applied as split in the experiment: 60% nitrogen as base fertilizer and the rest as dressing fertilizer at tillering stage
- Randomized complete block design with three replications

Notes: 1) All treatments received 150 kg N ha^{-1} 75 kg P_2O_5 ha^{-1}.
Source: 19000-SAAS-19017-17.

MATERIAL AND METHODS (2)

- To determine the effectiveness of POLY4 as a nutrient source for rice production
  - Yield
  - Tissue nutrient concentrations
  - Change in soil nutrients

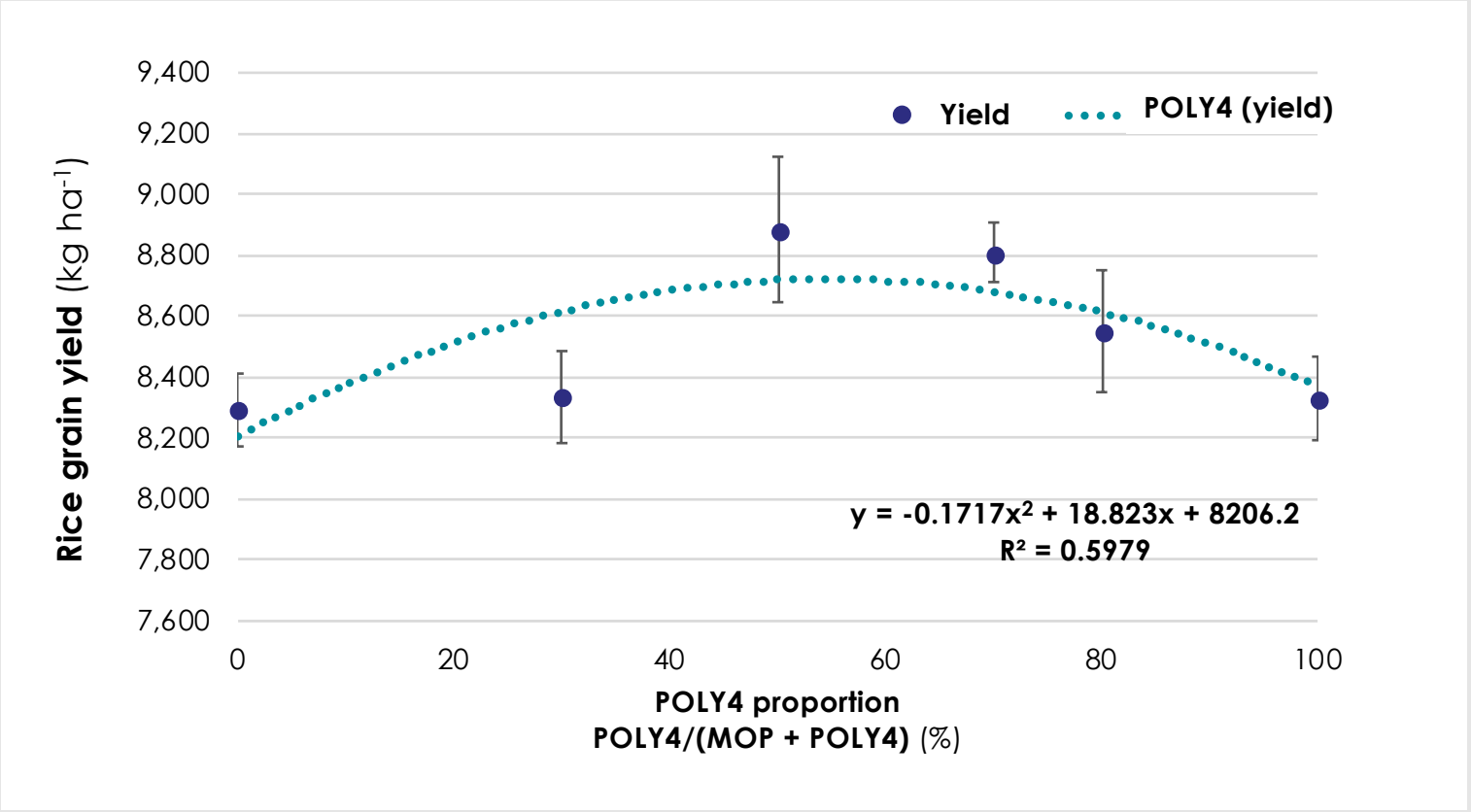
Notes: 1) All treatments received 150 kg N ha^{-1} 75 kg P_2O_5 ha^{-1}.
Source: 19000-SAAS-19017-17.

APPLYING POLY4 COMPARED WITH CONTROL

SEVEN TREATMENTS IN THE FIELD

YIELD RESULTS (1)

Response of rice grain yields to POLY4 proportion in the same K rate (135 kg K_2O ha^{-1}) applied

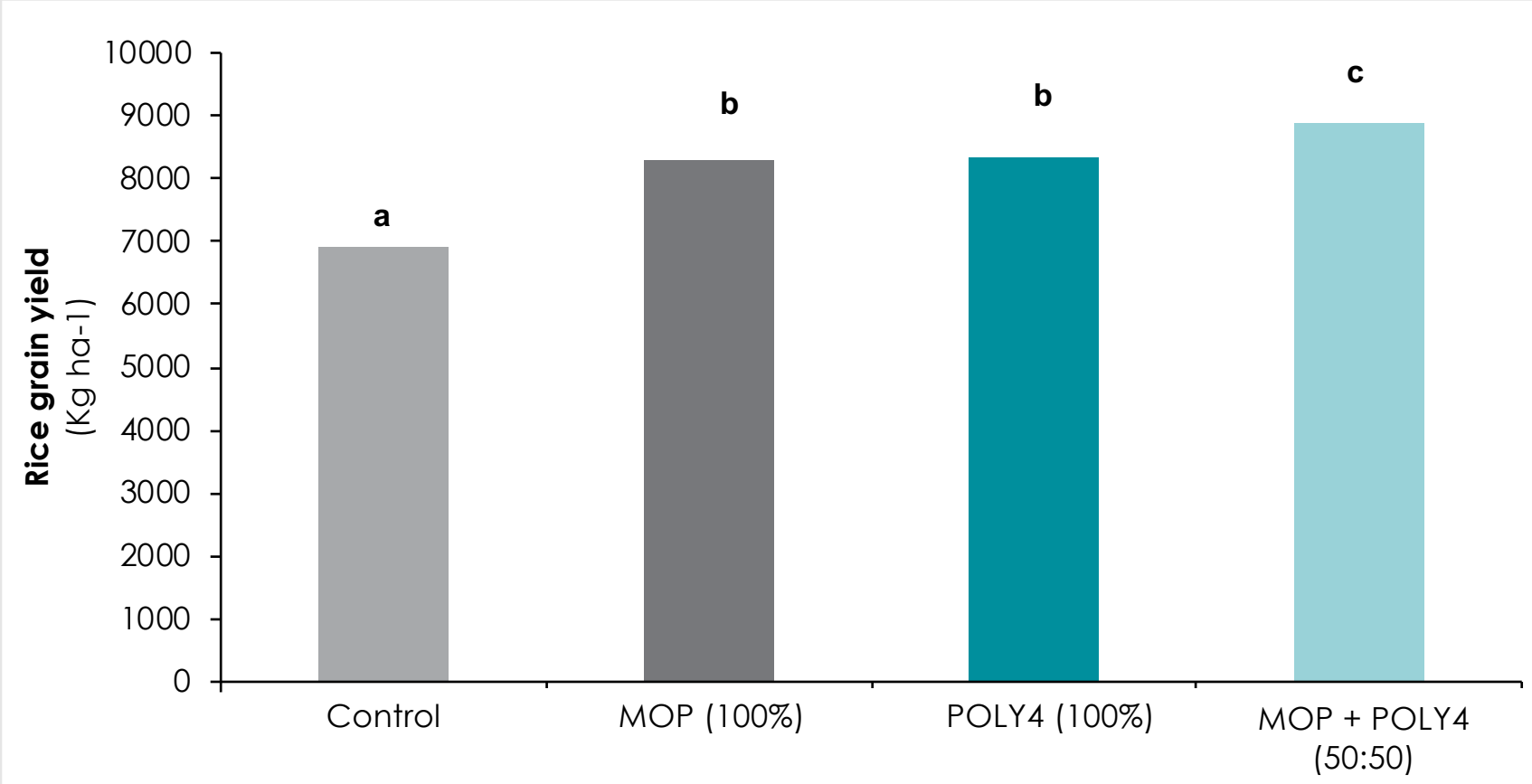


There was a polynomial equation between rice yield and applied S amount associated with POLY4 ($Y= -0.0512x^2 + 10.273x + 8206.2$, $R^2 = 0.5976$, Y= rice yield, x = S input).

Notes: 1) All treatments received 150 kg N ha^{-1} 75 kg P_2O_5 ha^{-1}.
Source: 19000-SAAS-19017-17.

YIELD RESULTS (2)

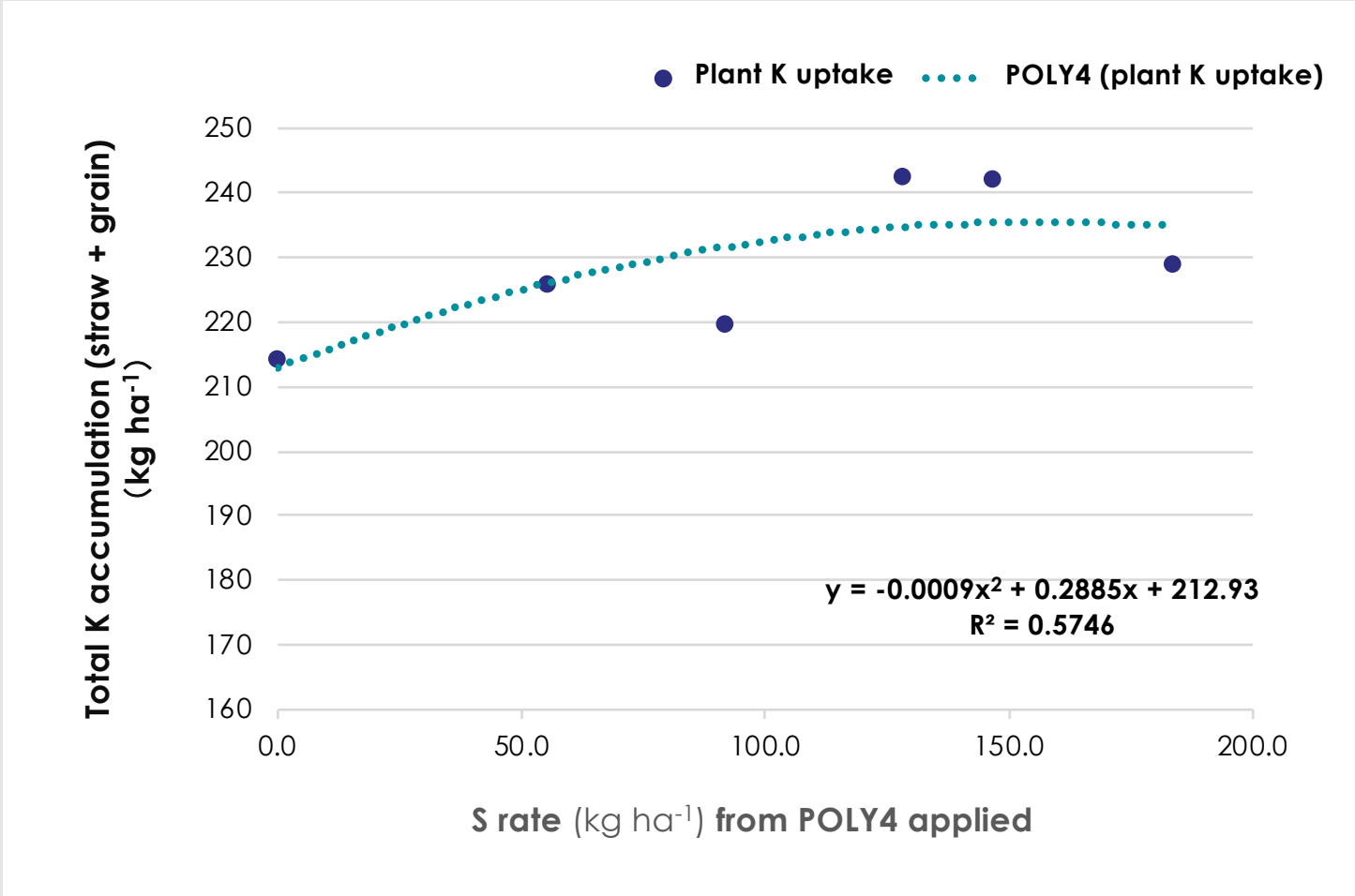
Rice grain yields for different K source



Notes: 1) All treatments received 150 kg N ha^{-1} 75 kg P_2O_5 ha^{-1}.
Source: 19000-SAAS-19017-17

K ACCUMULATION

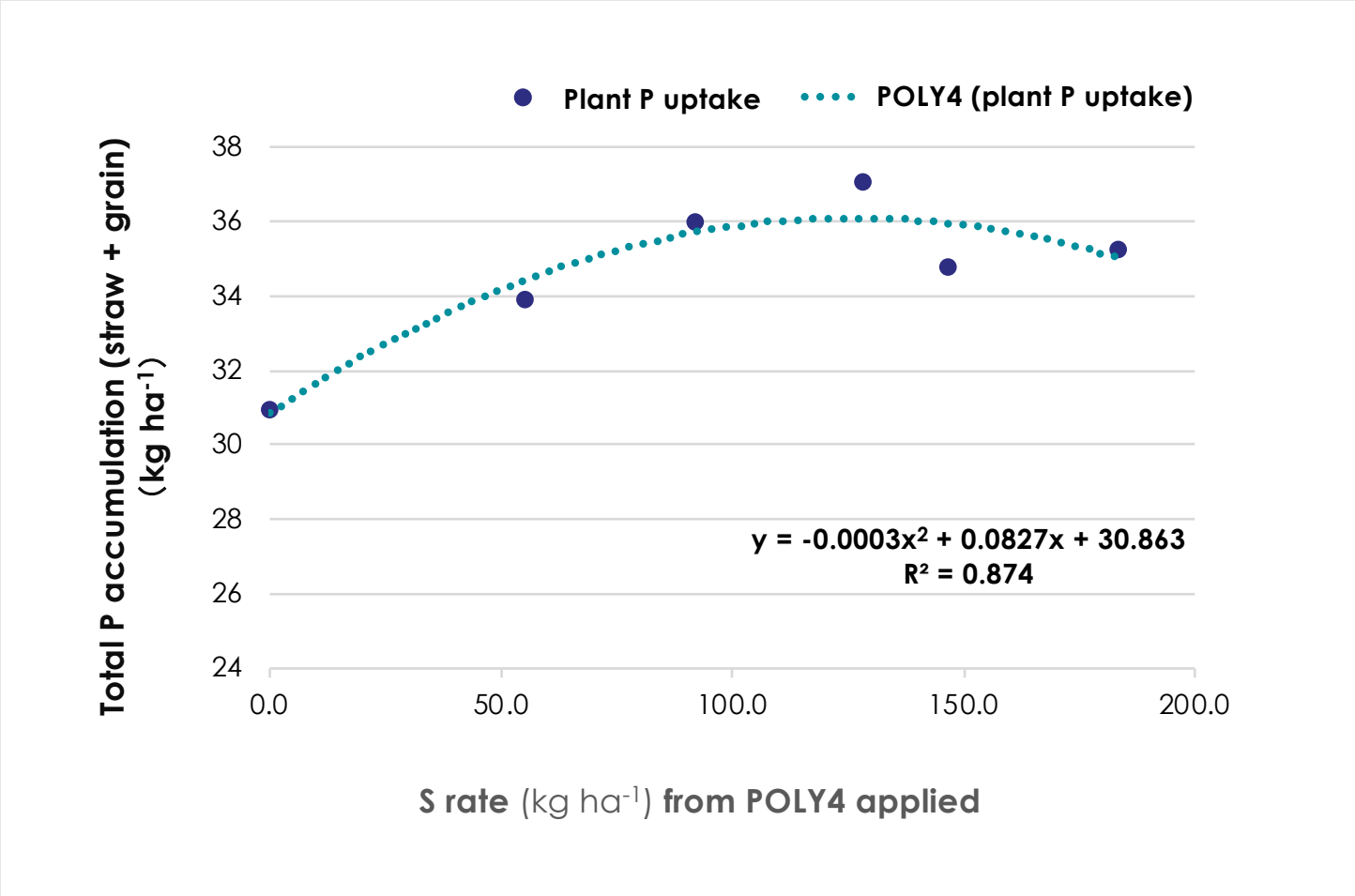
Response of total K accumulation (straw + grain) to S rate from POLY4 applied



Source: 19000-SAAS-19017-17

P ACCUMULATION

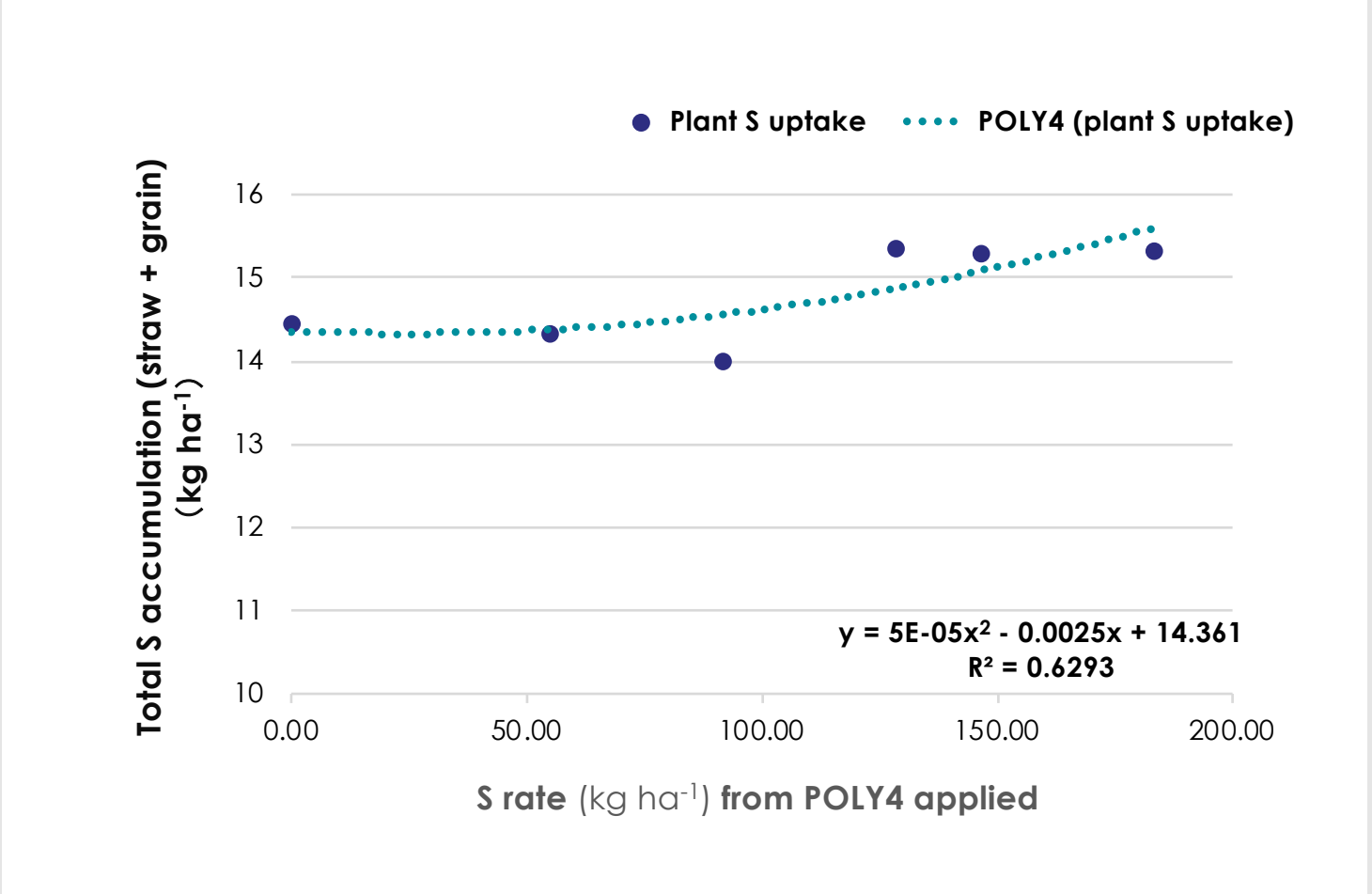
Response of total P accumulation (straw + grain) to S rate from POLY4 applied



Source: 19000-SAAS-19017-17

S ACCUMULATION

Response of total S accumulation (straw + grain) to S rate from POLY4 applied



Source: 19000-SAAS-19017-17

A SIGNIFICANTLY POSITIVE CORRELATION BETWEEN RATE OF INPUT S AND P CONTENT IN RICE GRAIN, Mn CONTENT IN STRAW, POST-HARVEST SOIL-AVAILABLE S CONTENT

	P content in grain ($g\ kg^{-1}$)	**Mn content in straw** ($mg\ kg^{-1}$)	**Post-harvest soil-available S content** ($mg\ kg^{-1}$)
S rate from POLY4	$r = 0.524$, $p < 0.05$	$r = 0.462$, $p < 0.05$	$r = 0.585$, $p < 0.05$

Source: 19000-SAAS-19017-17

POST-HARVEST SOIL AVAILABLE K AND S CONTENT

	Post-trial available K content (mg kg^{-1})	**Post-trial available S content** (mg kg^{-1})
Control	121.5 a	152.6 a
MOP	133.6 b	186.8 b
POLY4	146.4 c	232.6 c

Source: 19000-SAAS-19017-17

CONCLUSIONS

- Applying POLY4 combined with MOP gave a better rice yield response than applying MOP or POLY4 alone; and rice grain yield varied with different blend ratios of POLY4 with MOP

- Rice grain yield, total K and P accumulation (straw + grain) improved with increasing S supply from POLY4 at low S input rate and decreased at high S input rate

- A significantly positive correlation between rate of input S and P content in rice grain, Mn content in straw, post-harvest soil available S content

- POLY4 (100%) significantly increased post-trial soil available K content over MOP(100%)

Source: 19000-SAAS-19017-17

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THANK YOU

Any questions please contact:

xiaohui.fan@siriusminerals.com

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