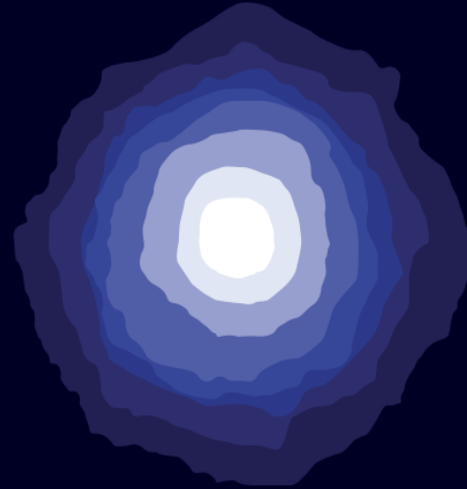


# SIRIUS

MINERALS PLC



*THE FUTURE OF  
FERTILIZER*

Chilli pepper results  
May 2016

# Important Notices



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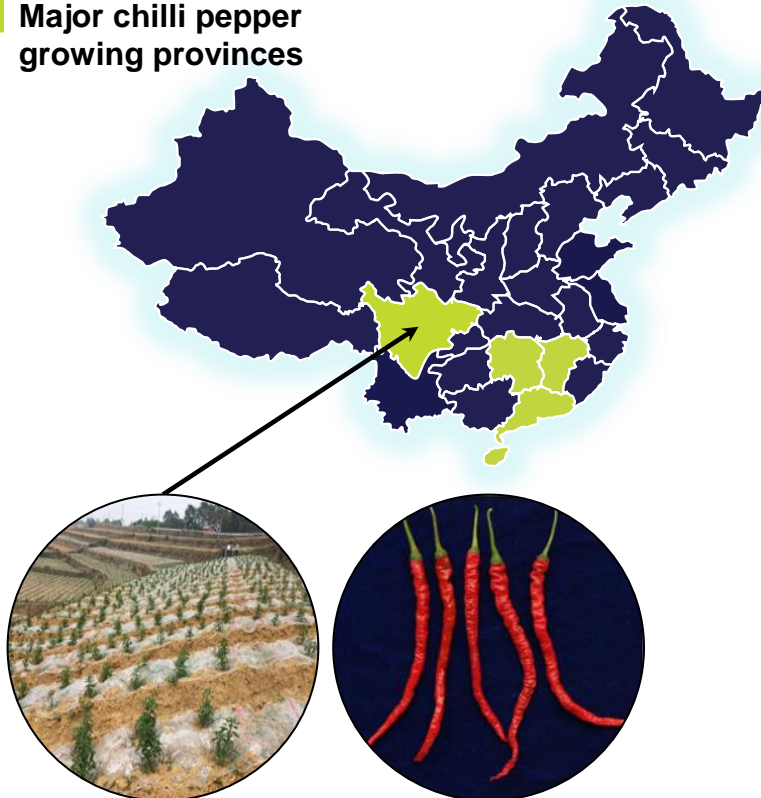
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# Chilli pepper production in China

China is the world's largest producer of chilli peppers

## Chinese chilli pepper production<sup>1</sup>

■ Major chilli pepper growing provinces



## Key facts

- The global fresh chilli pepper market is estimated to be worth \$US29.45 billion<sup>2</sup>
- China is the lead global producer of chilli peppers producing 15.8 Mt in 2013<sup>2</sup>
- This translates into a 39% financial share of the global market
- Hainan, Hunan, Sichuan, Guangdong and Jiangxi are the main provinces accounting for 94% of chilli pepper production in China<sup>1</sup>
- Chilli peppers require high amounts of magnesium and potassium from low chloride content fertilizer sources<sup>3</sup>

**China dominates global chilli pepper production**

# Treatment structure

Evaluation of two potassium based fertilizer blends on chilli peppers

## Average treatment composition<sup>1,2</sup>

Fertilizer	Nutrient application (kg/ha)						
	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	MgO	CaO	S	Cl
SOP based NPK (15:10:15)	144	97	145	0	0	52	6
POLY4 based NPK (15:10:15)	144	97	145	17	48	93	10

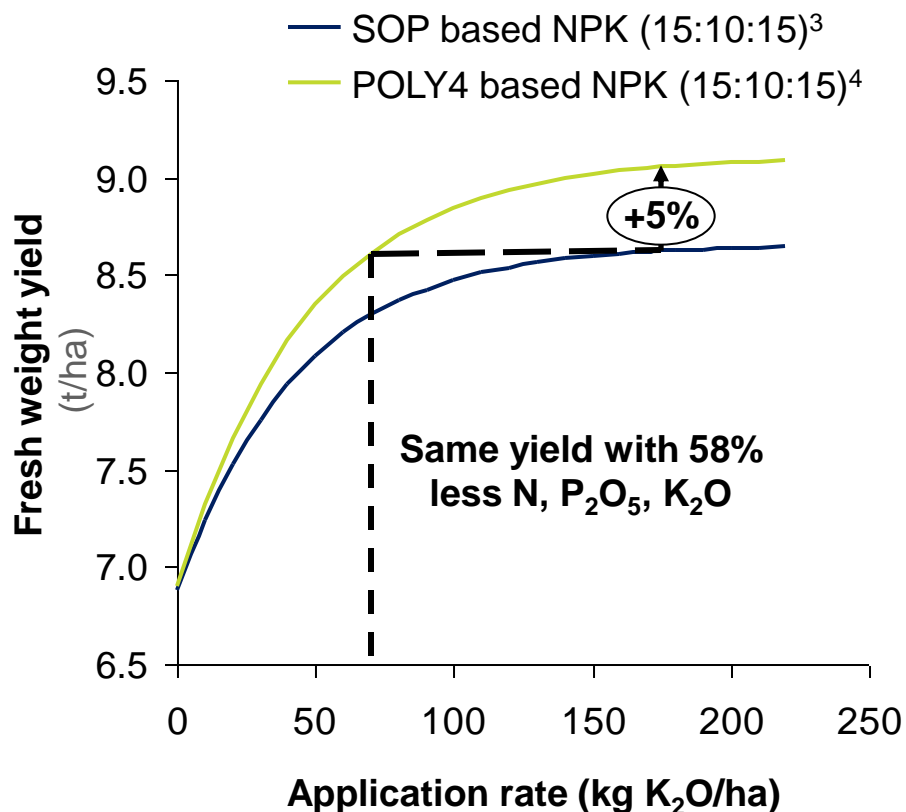
- In this trial, four rates of K<sub>2</sub>O application (53, 88, 175 and 263 kg K<sub>2</sub>O/ha) were used to compare SOP and POLY based blend options
- At flowering, both the SOP and POLY4 NPK blend plots were given a top dressing of 90 kg N/ha from urea
- The POLY4 option supplies additional magnesium and calcium plus beneficial micro-nutrients beyond the SOP based option
- Plots measuring 15 m<sup>2</sup> each were used for all treatment and rate combinations

**Trial was designed to evaluate two sources of potassium at four rates**

# Chilli pepper yield

POLY4 blends offer a practical alternative to SOP blends

## Fresh chilli pepper yield<sup>1,2</sup> (t/ha)



## Key findings

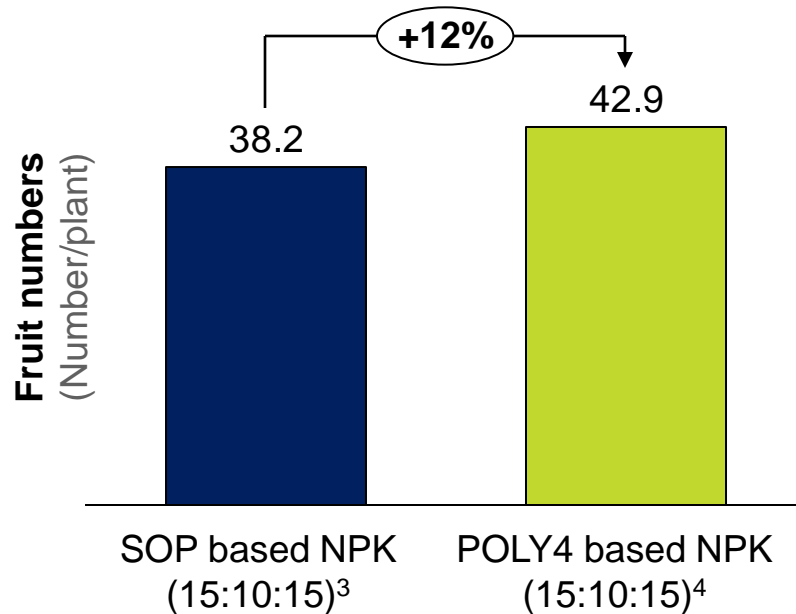
- In this field trial in Sichuan, a POLY4 based NPK blend was compared with an SOP based NPK blend in a rate response study on hot chilli peppers
- The POLY4 based NPK blend doubled the sulphur content from 5% to 10%, supplied 2% MgO and 5% CaO
- The source of magnesium and calcium coupled with potassium from POLY4 in the blend is more suited to the chilli pepper plant needs
- The POLY4 based NPK 15:10:15 blend outperformed the SOP based NPK 15:10:15 blend, with a 5% yield improvement at the recommended 175 kg K<sub>2</sub>O/ha application rate

**The POLY4 blend improved chilli pepper yield**

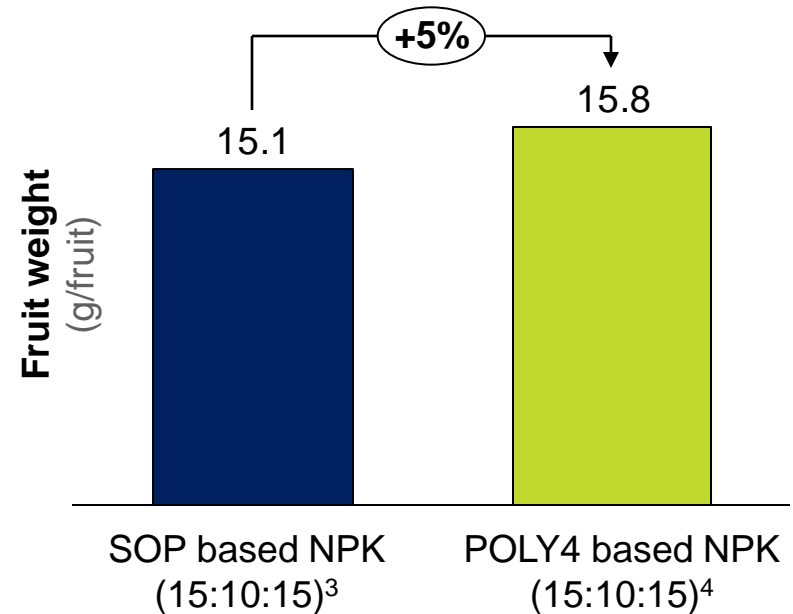
# Yield components

The POLY4 blend boosted fruit numbers and weight to improve yield

**Fruit numbers**<sup>1,2</sup>  
(number/plant)



**Fruit weight**<sup>1,2</sup>  
(g/fruit)



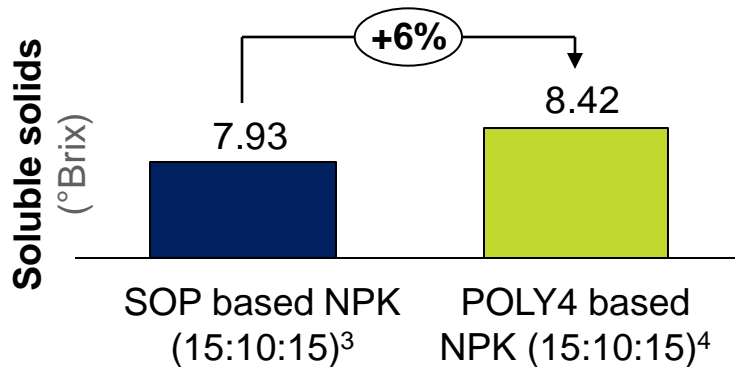
- The POLY4 based NPK (15:10:15) blend significantly increased fruit numbers by 12%
- In addition, the POLY4 based (15:10:15) blend significantly increased fruit weight by 5%
- Increasing both the number of chilli peppers and their weight leads to increased yield

**POLY4 blends significantly improved both yield components**

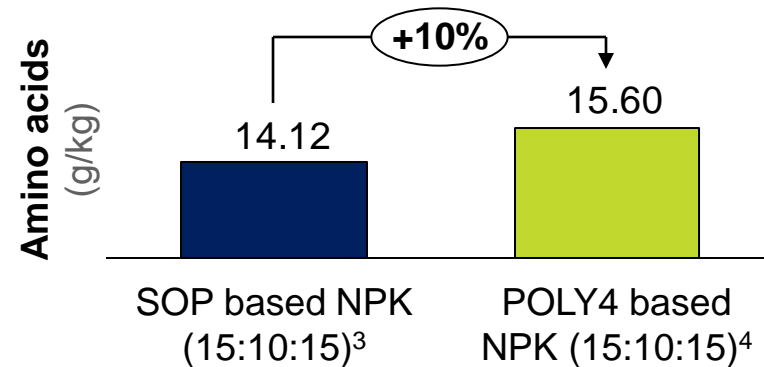
# Quality parameters (part 1)

Improving chilli pepper quality is essential to increasing returns to the farmer

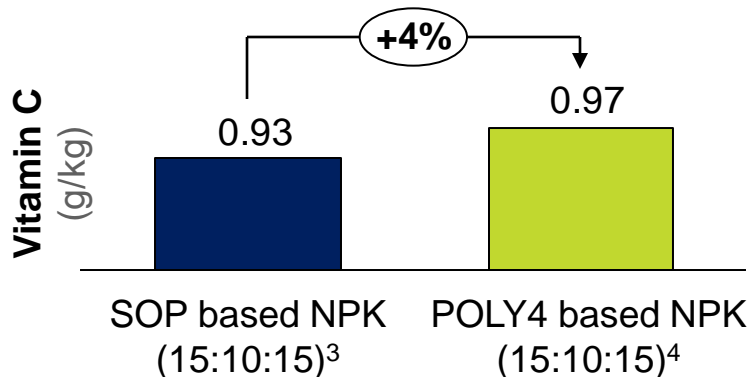
## ① Soluble solids<sup>1,2</sup> (°Brix)



## ② Amino acid<sup>1,2</sup> (g/kg)



## ③ Vitamin C<sup>1,2</sup> (g/kg)



## ④ Key comments

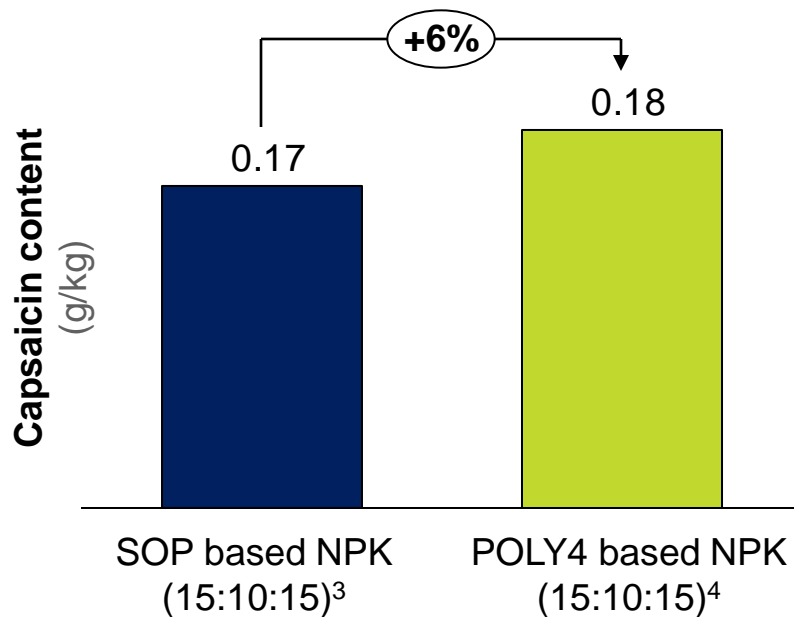
- The POLY4 based NPK significantly improved soluble solid content which can extend shelf life
- Significantly higher amino acids, achieved with the POLY4 based NPK, indicate good protein synthesis
- Elevated vitamin C content has a value to consumers and was significantly higher with the POLY4 based NPK

**The POLY4 based NPK blend significantly improve fruit quality and dietary value**

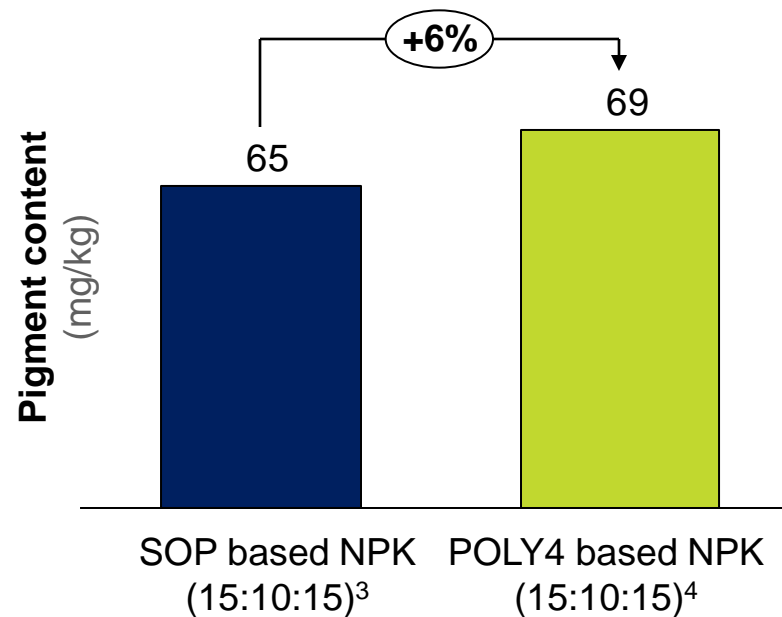
# Quality parameters (part 2)

Improving capsaicin content and colour increases consumer and grower desirability

**Capsaicin content (spicy heat)<sup>1,2</sup>**  
(g/kg)



**Capsicum pigment content<sup>1,2</sup>**  
(mg/kg)



- Capsaicin evolved as a natural anti-fungal (against *Fusarium spp.*) but also acts as a deterrent to mammalian vermin
- Colour changes from capsicum pigment content largely reflect fruit maturity but delays caused by excess nitrogen nutrition can reduce the formation of the red pigment

**The POLY4 based NPK blend provides a suitable fertilizer strategy to improve capsaicin content and fruit colour**

Notes: 1) GENSTAT means; 2) Top dressing of 90 kg N/ha from urea applied at flowering; 3) SOP based NPK (15:10:15) blend made from MAP, urea and SOP; 4) POLY4 based NPK (15:10:15) blend made from POLY4, MAP, urea and SOP. Initial soil analysis: pH 5.2, organic matter 2%, N 69 mg/kg, P 37 mg/kg, K 78 mg/kg, Ca 1710 mg/kg, Mg 80 mg/kg, S 65 mg/kg, EC 0.104 mS/cm. Sources: Sichuan Academy of Agricultural Science 2015

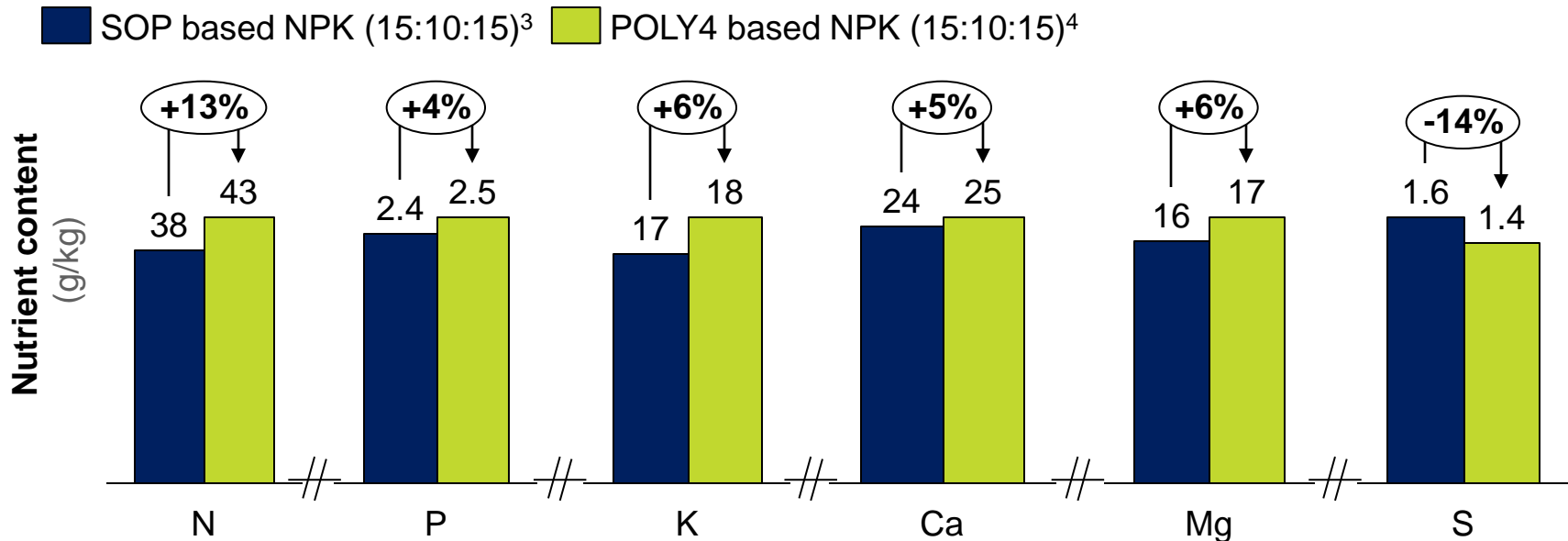


# Leaf nutrient content

Analysis of leaf nutrients is an indication of nutritional status

## Chilli pepper leaf nutrient content<sup>1,2</sup>

(g/kg)



- Leaf nutrient content is the preferred assay to assess crop nutritional status
- The POLY4 based NPK blend supports a good standard of crop nutrition
- Significantly higher nutrient concentrations were found for nitrogen, phosphorus and potassium using the POLY4 based NPK blend

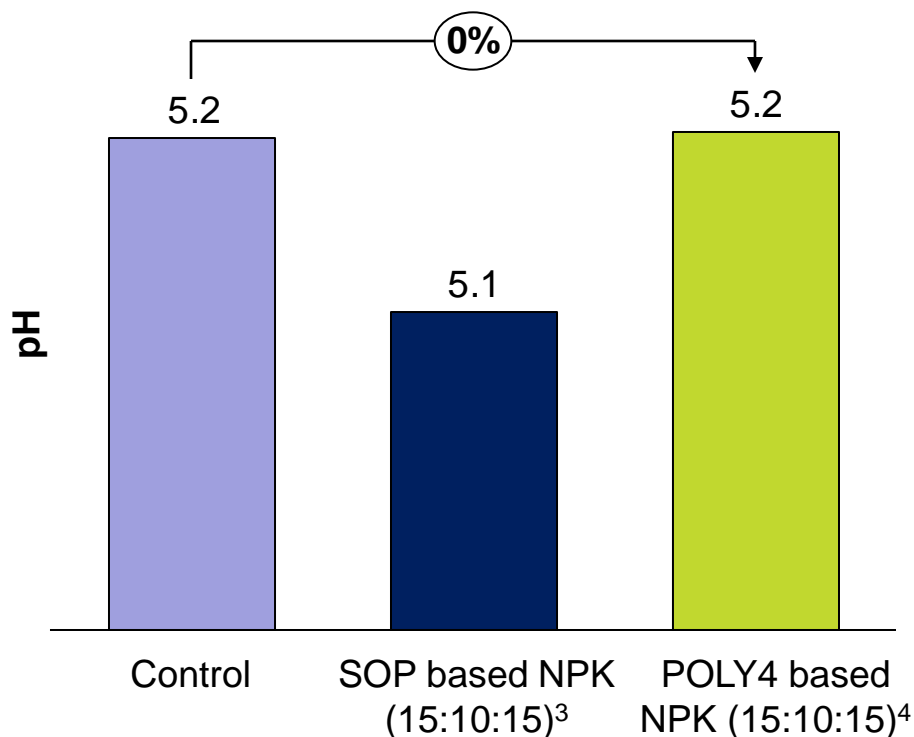
**The POLY4 based NPK blend supports yield, quality and crop health with enhanced nutrition**

Notes: 1) GENSTAT means; 2) Top dressing of 90 kg N/ha from urea applied at flowering; 3) SOP based NPK (15:10:15) blend made from MAP, urea and SOP; 4) POLY4 based NPK (15:10:15) blend made from POLY4, MAP, urea and SOP. Initial soil analysis: pH 5.2, organic matter 2%, N 69 mg/kg, P 37 mg/kg, K 78 mg/kg, Ca 1710 mg/kg, Mg 80 mg/kg, S 65 mg/kg, EC 0.104 mS/cm. Sources: Sichuan Academy of Agricultural Science 2015

# Post-harvest soil pH

Maintenance of soil pH assures nutrient availability

## Soil pH<sup>1,2</sup>



## Key findings

- Soil pH effects chemical and biological processes in the soil
- Acidification (decreasing pH) reduces the availability of many nutrients to plants resulting in yield penalties
- Correcting undesirable soil pH requires expensive, long term remediation programmes that commonly also affect the availability of some nutrients in the short term
- In this trial, the POLY4 based NPK blend significantly differed from the SOP based NPK blend in that it does not cause pH drift

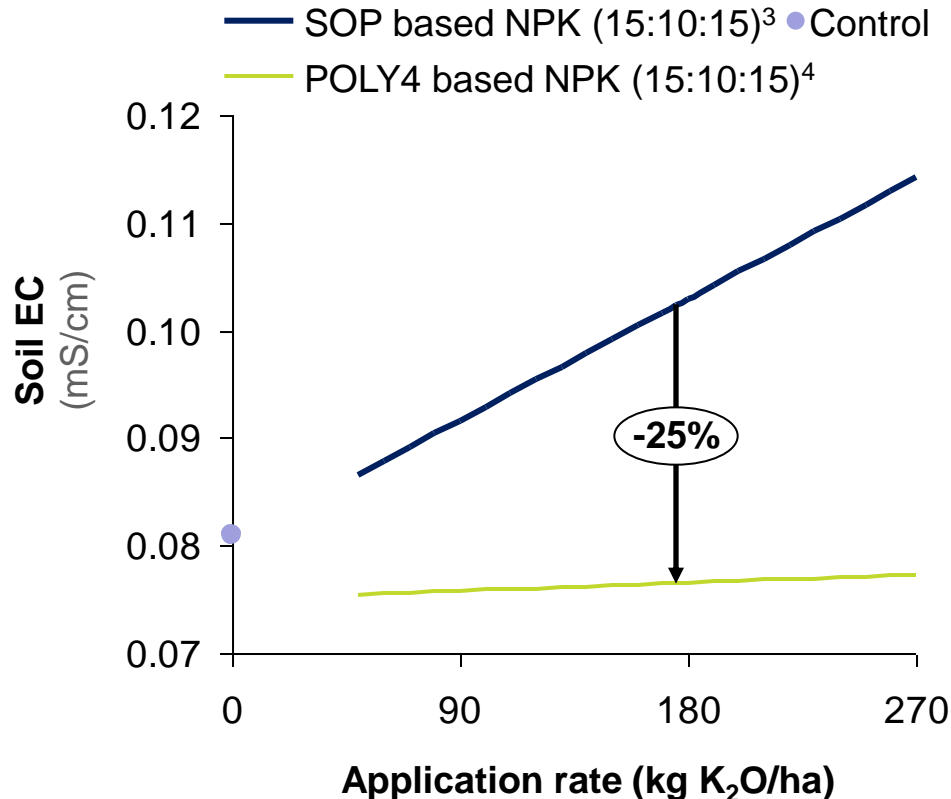
**POLY4 in blends does not cause soil acidification**

Notes: 1) GENSTAT means; 2) Top dressing of 90 kg N/ha from urea applied at flowering; 3) SOP based NPK (15:10:15) blend made from MAP, urea and SOP; 4) POLY4 based NPK (15:10:15) blend made from POLY4, MAP, urea and SOP. Initial soil analysis: pH 5.2, organic matter 2%, N 69 mg/kg, P 37 mg/kg, K 78 mg/kg, Ca 1710 mg/kg, Mg 80 mg/kg, S 65 mg/kg, EC 0.104 mS/cm. Sources: Sichuan Academy of Agricultural Science 2015

# Post-harvest soil EC

Maintaining lower soil EC supports crop development

**Soil EC<sup>1,2</sup>**  
(mS/cm)



## Key findings

- Fertilizers are soluble salts that can increase soil salinity
- High soil EC inhibits seed germination and a plant's uptake of water and nutrients
- The SOP based NPK blend demonstrates an increasing soil EC with application rate
- Plots that had the POLY4 based NPK blend applied showed a 25% reduction in soil EC, at a recommended 175 kg K<sub>2</sub>O/ha, compared to the SOP based NPK blend

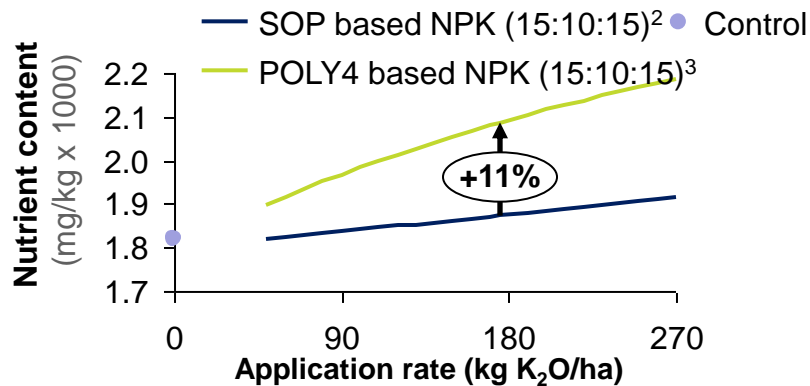
**Blends with POLY4 showed a significant decrease in post-harvest soil EC**

Notes: 1) GENSTAT regression analysis; 2) Top dressing of 90 kg N/ha from urea applied at flowering; 3) SOP based NPK (15:10:15) blend made from MAP, urea and SOP; 4) POLY4 based NPK (15:10:15) blend made from POLY4, MAP, urea and SOP. Initial soil analysis: pH 5.2, organic matter 2%, N 69 mg/kg, P 37 mg/kg, K 78 mg/kg, Ca 1710 mg/kg, Mg 80 mg/kg, S 65 mg/kg, EC 0.104 mS/cm. Sources: Sichuan Academy of Agricultural Science 2015

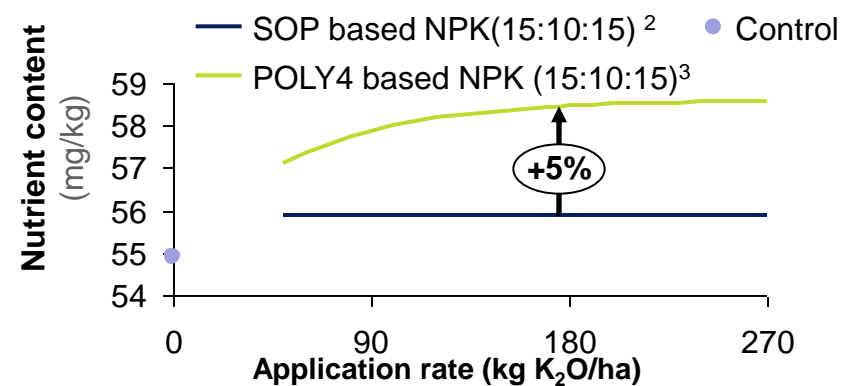
# Post-harvest soil secondary nutrients levels

Increasing soil nutrient status for subsequent crops

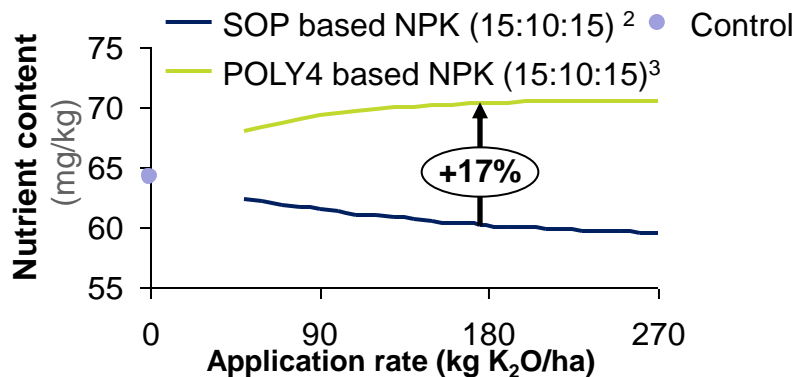
## 1 Post-harvest residual soil calcium<sup>1</sup> (mg/kg x 1000)



## 2 Post-harvest residual soil magnesium<sup>1</sup> (mg/kg)



## 3 Post-harvest residual soil sulphur<sup>1</sup> (mg/kg)



## 4 Key comments

- The post-harvest soil nutrient status demonstrates the value of additional nutrients in the POLY4 NPK blend
- Enhancing residual soil nutrients can benefit subsequent crops
- POLY4 NPK blends showed consistent increases in post-harvest soil nutrient levels at the recommended application rate of 175 kg K<sub>2</sub>O/ha

**POLY4 increases soil nutrient status enhancing fertility  
for subsequent crops**

# Chilli pepper presentation summary

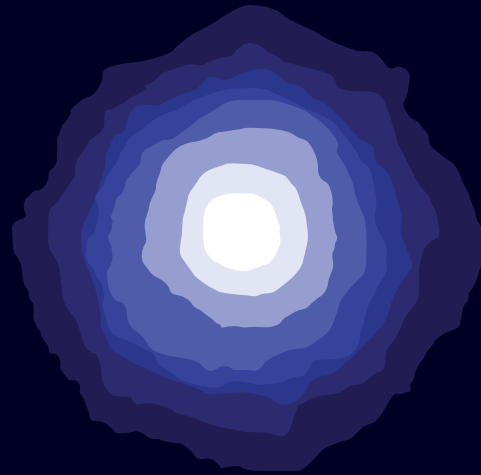
POLY4 delivers balanced fertilization in blends to chilli peppers

## Chilli pepper key conclusions

- In the province of Sichuan, a POLY4 based NPK (15:10:15) blend<sup>1</sup> was assessed against a SOP based NPK (15:10:15) chilli pepper blend<sup>2</sup> in a field trial
- The POLY4 based NPK (15:10:15) outperformed the SOP based NPK (15:10:15), increasing yields by 5%, at the recommended 175 kg K<sub>2</sub>O/ha due to the additional magnesium and calcium provided by POLY4
- Significantly, the number of chilli peppers and their weight were increased by 12% and 5% respectively, improving yield
- Quality parameters of soluble solids, amino acids and vitamin C were all significantly higher when using the POLY4 blend
- Capsaicin content, colour and nutrient status in the plant were improved with the POLY4 blend
- No negative effects on soil pH or EC were observed when using the POLY4 blend
- Valuable improvements in residual soil calcium, magnesium and sulphur differentiates the POLY4 NPK blend from the SOP NPK blend



**Blends containing POLY4 are advantageous to chilli pepper growers**



Thank you