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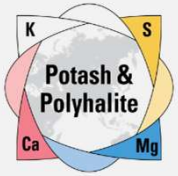
POLYHALITE IN THE CONTEXT OF POTASH FERTILIZERS

Patricia Imas
International Potash Institute, Switzerland

13th IPI-CAU-ISSAS International Symposium
6-8 November 2019, Kunming, China



POTASSIUM ROLE IN PLANTS

- Adsorbed as K^+
- Important in plant water uptake and balance through effect on osmotic potential
- Cation balance for anion transport
- Cofactor for many enzymes
- Used in many process such as synthesis of proteins, ATP and in photosynthesis
- However not a constituent of any compounds
- Mobile in the plant

Carrot response to K application in India
(source: Potash for Life)

K deficiency symptoms in alfalfa in India
(source: IPI)

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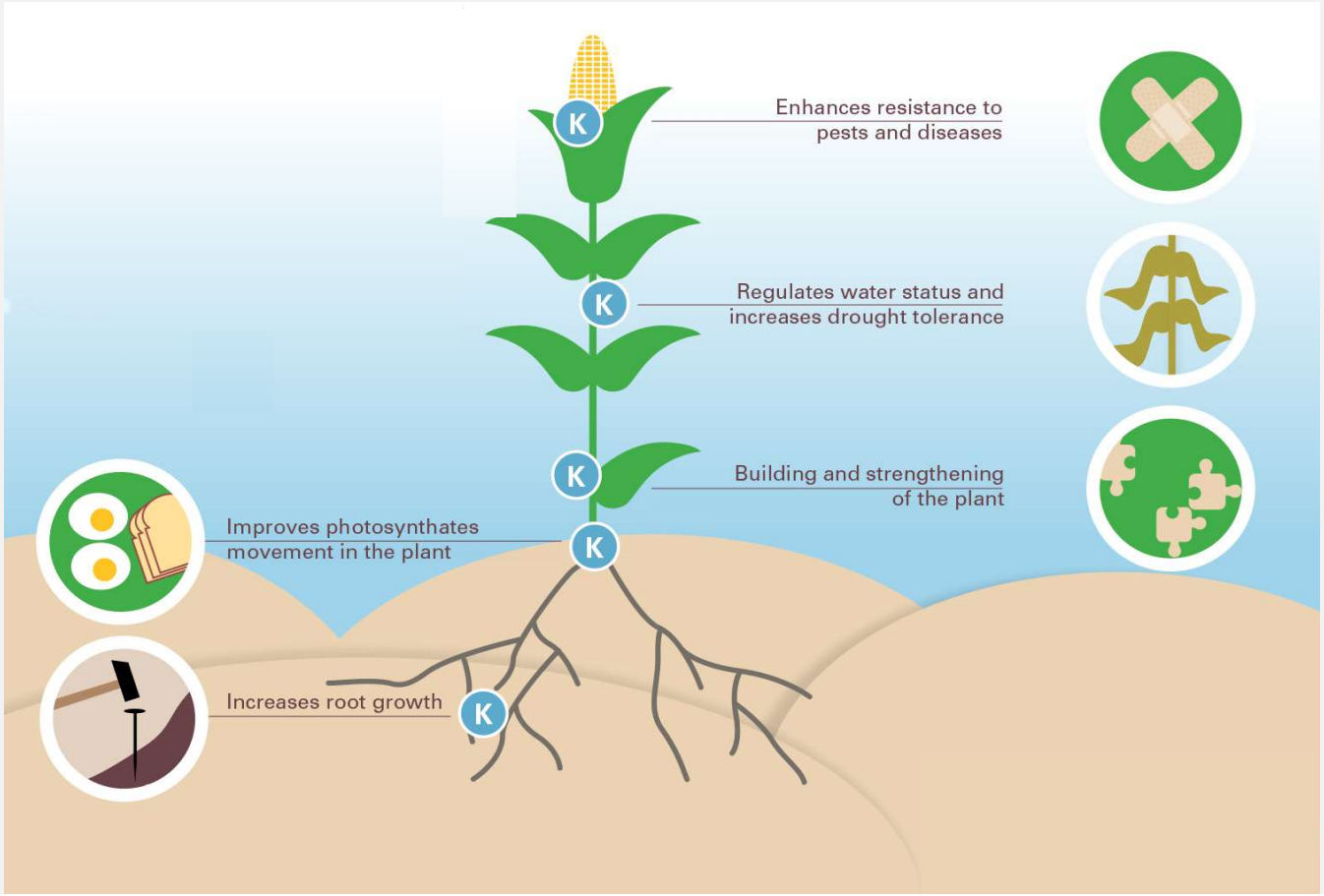
POTASSIUM ROLE IN PLANTS



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POTASSIUM (K) = QUALITY

Improves QUALITY of grains, vegetables & fruits:

- Grains are bolder and more shining
- Fruits & vegs have bigger size
- Fruits & vegs have better color and flavor
- Uniform ripening
- Less fissures, cracks and lesions
- Less incidences of diseases
- Higher nutritional value (more protein, oil and vitamin C content in grains and fruits)
- Improved storage, transportation & longer shelf life

Tomato response to K application in India
(source: Potash for Life)

Mango response to K application in India
(source: IPI)

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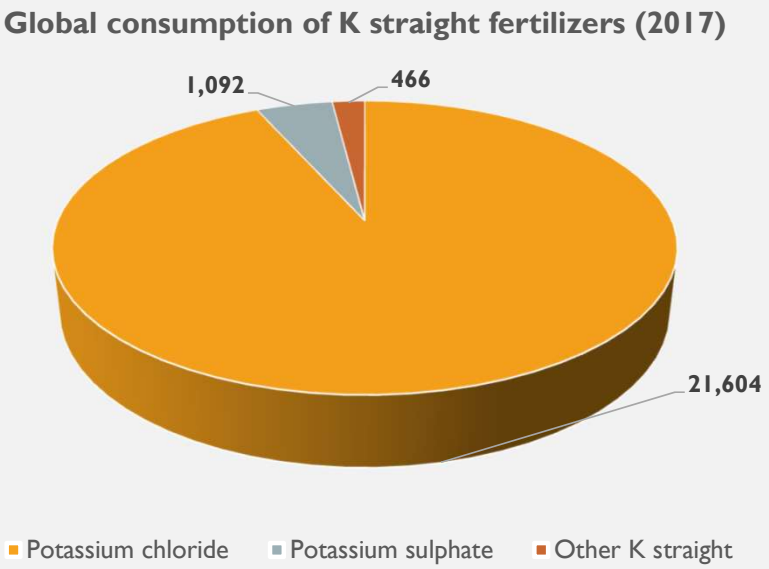
WORLD POTASSIUM CONSUMPTION



- World total consumption: 37,834,200 MT K_2O
- 93% is consumed at potassium chloride (MOP, KCl)

Source: IFA (International Fertilizer Association)

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POTASH FERTILIZERS

Fertilizer	Chemical composition	K_2O (%)	Remarks
Muriate of potash	KCl	60	Contains chloride
Potassium sulphate	K_2SO_4	50	Immediate S leaching
Potassium nitrate	KNO_3	46	Contains nitrogen
Sulphate potash magnesia	$K_2SO_4 \cdot MgSO_4$	22	Immediate S leaching
Kainite	$KCl + NaCl + MgSO_4$	10	Contains chloride
Polyhalite	$K_2Ca_2Mg(SO_4)_4 \bullet 2(H_2O)$	14	Low chloride, prolonged availability of nutrients, 4 nutrients in one fertilizer

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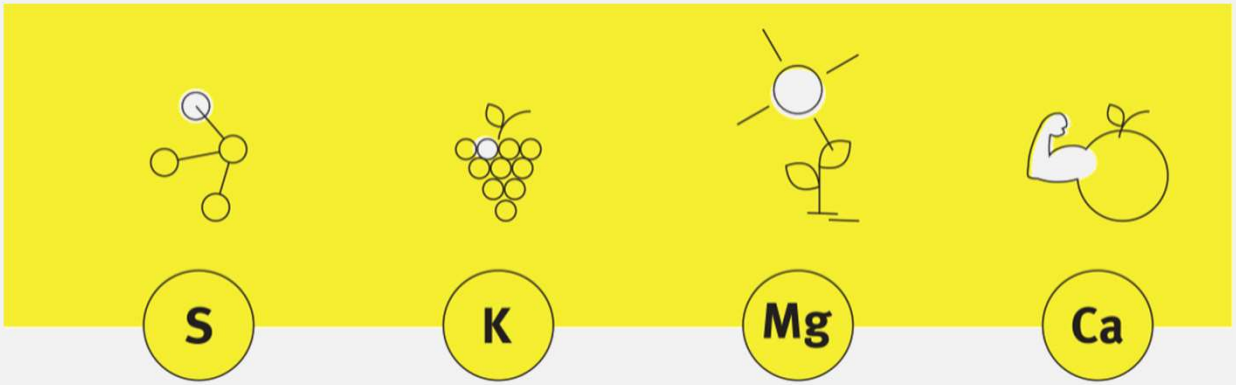
POLYHALITE A NEW K FERTILIZER



48% SO_3 (19.2% S)
As sulphate

An essential constituent of all proteins

14% K_2O (11.6% K)
As potassium sulphate

Secures yield and quality

6% MgO (3.6% Mg)
As magnesium sulphate

For high photosynthesis

17% CaO (12.2% Ca)
As calcium sulphate

For strong and healthy crop

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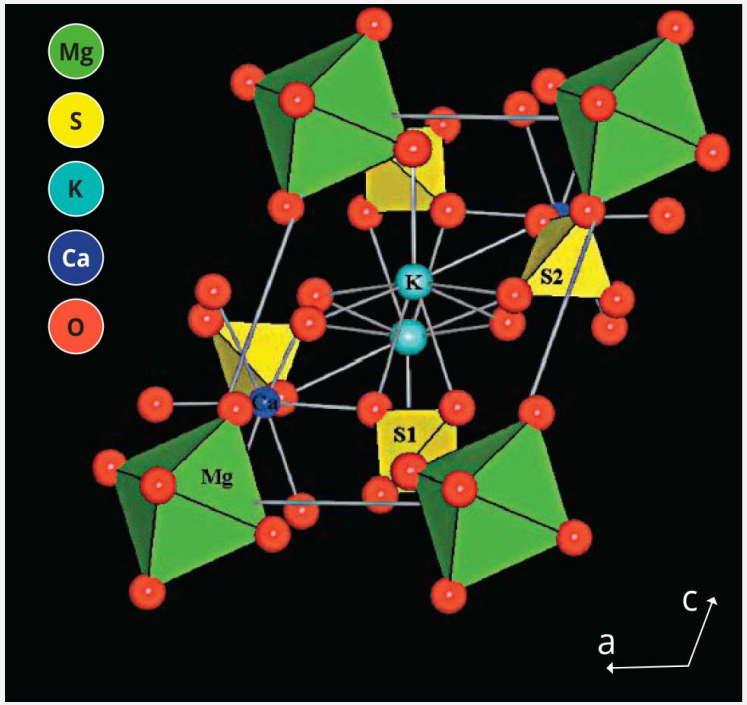
POLYHALITE IS A MINERAL, NOT A MIXTURE OF SALTS

The crystal structure of polyhalite



$K_2Ca_2Mg(SO_4)_4 \cdot 2(H_2O)$

ONE single complex crystal

Source: Reinvestigation of polyhalite, $K_2Ca_2Mg(SO_4)_4 \cdot 2H_2O$. Luca Bindi; Acta Crystallographica Section E Structure Reports Online / ISSN 1600-5368. Editors: W. Clegg and D. G. Watson

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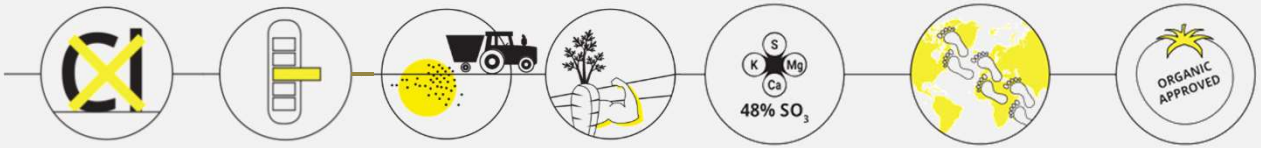
POLYHALITE A NEW K FERTILIZER

- Provides 4 nutrients in one: K + secondary nutrients
- Single complex crystal, not a mixture of salts
- A pure, natural mineral without any added chemicals
- Very low chloride, ideal for chloride-sensitive crops
- Suits all crops and soil types
- Low salt index and neutral pH
- Fully soluble, with gradual release the nutrients for plant uptake (prolonged availability)
- Better for the environment - less risk of leaching
- Residual effect for next crop
- Approved for use in organic agriculture, with a low carbon footprint



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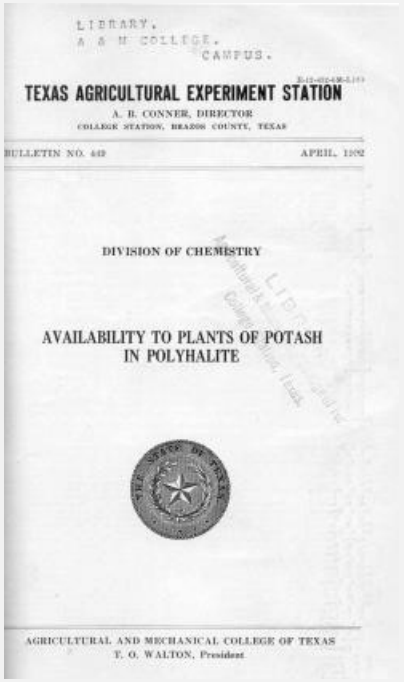
1ST EXPERIMENT WITH POLYHALITE

This report from April 1932 shows the 1st experiment with polyhalite



Source: Fraps, G.S. (1932). Availability to plants of potash in polyhalite. Texas Agricultural Experiment Station Bulletin No. 449. College Station, Texas.

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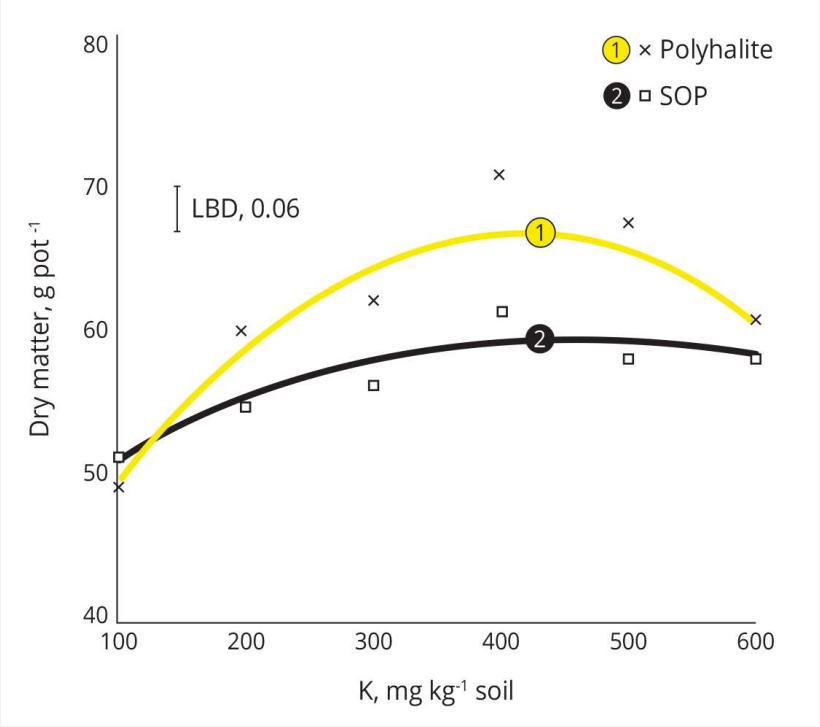
POLYHALITE – EARLY RESEARCH

Polyhalite application to sorghum-sudangrass and leaching in soil columns



Re-drawn from Barbarick, K.A. (1991). Soil Science 151(2), 159-166.

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POLYHALITE – EARLY RESEARCH

0038-075X/91/1512-0159$03.00/0
SOIL SCIENCE

February 1991
Vol. 151, No. 2
Printed in U.S.A.

POLYHALITE APPLICATION TO SORGHUM-SUDANGRASS AND LEACHING IN SOIL COLUMNS

K. A. BARBARICK[1]

izer treatments. In these studies, finely-ground polyhalite provided adequate K, Ca, Mg, and SO_4-S to the plants and performed somewhat like a slow-release fertilizer compared to more soluble fertilizer sources. This mineral should be an effective fertilizer in acid, infertile soils.

Source: Barbarick, K.A. (1991). Soil Science 151(2), 159-166.

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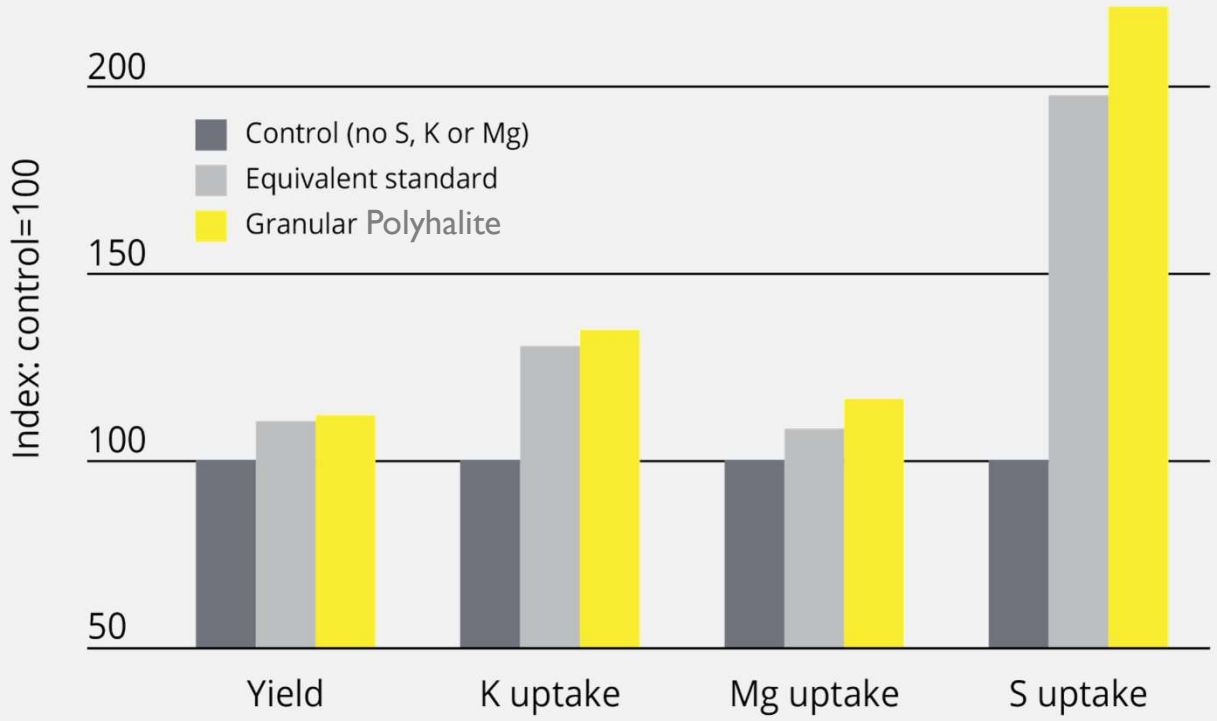
YIELD AND NUTRIENT UPTAKE FROM A REPLICATED GRASS FIELD TRIAL COMPARING POLYHALITE WITH EQUIVALENT STANDARD



80 kg/ha K_2O

Source: Trial carried out by Levington Agriculture, UK, on behalf of ICL (1999)

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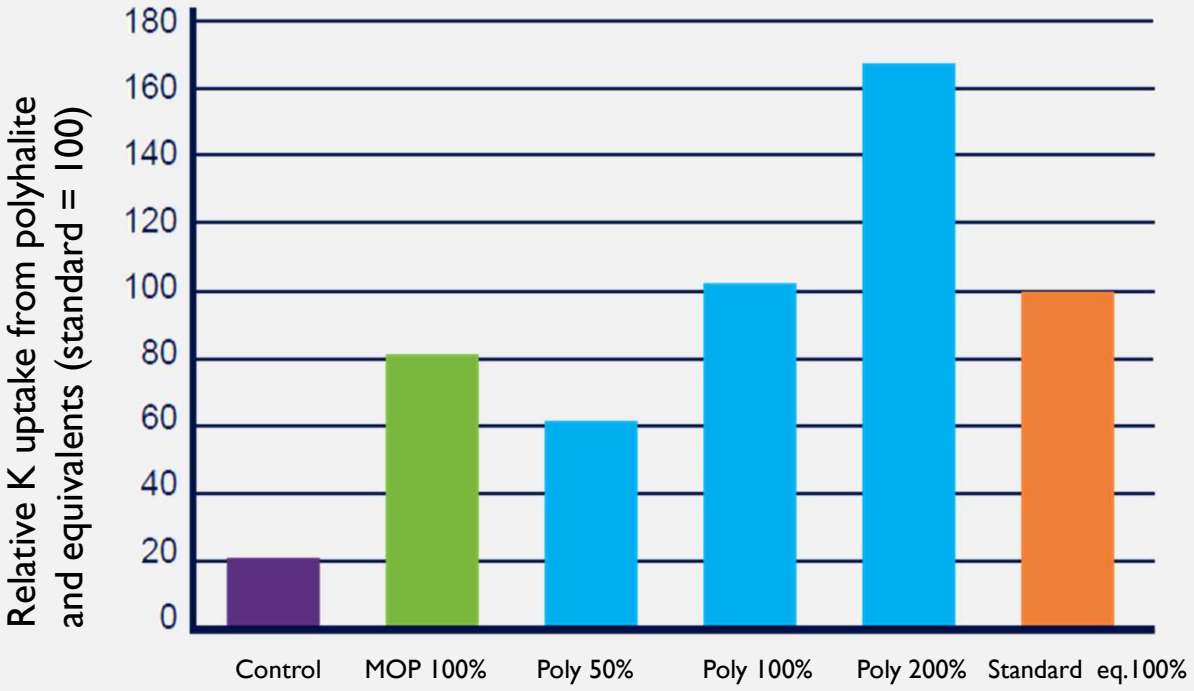
RELATIVE K UPTAKE FROM POLYHALITE AND MOP BY RYEGRASS (TOTAL OF 4 CUTS), POT EXPERIMENT



- Uptake of K from polyhalite was better than from MOP alone.
- High rates of polyhalite can further increase K uptake by ryegrass.

Source: Trial carried out by Stockbridge Technology Center, UK, on behalf of ICL (2009)

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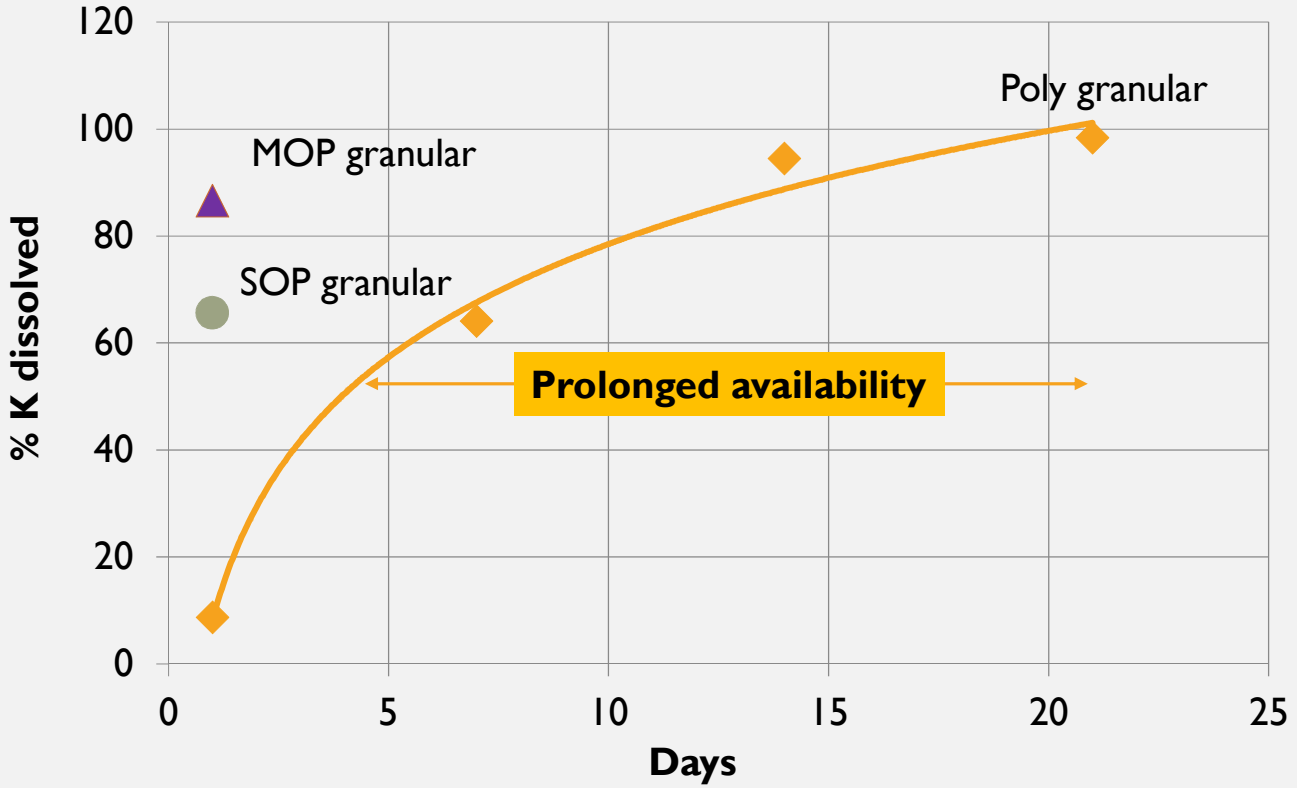
SOLUBILITY OF K FROM POLYHALITE, MOP AND SOP



Source: ICLSF lab R&D Netherlands, 2016

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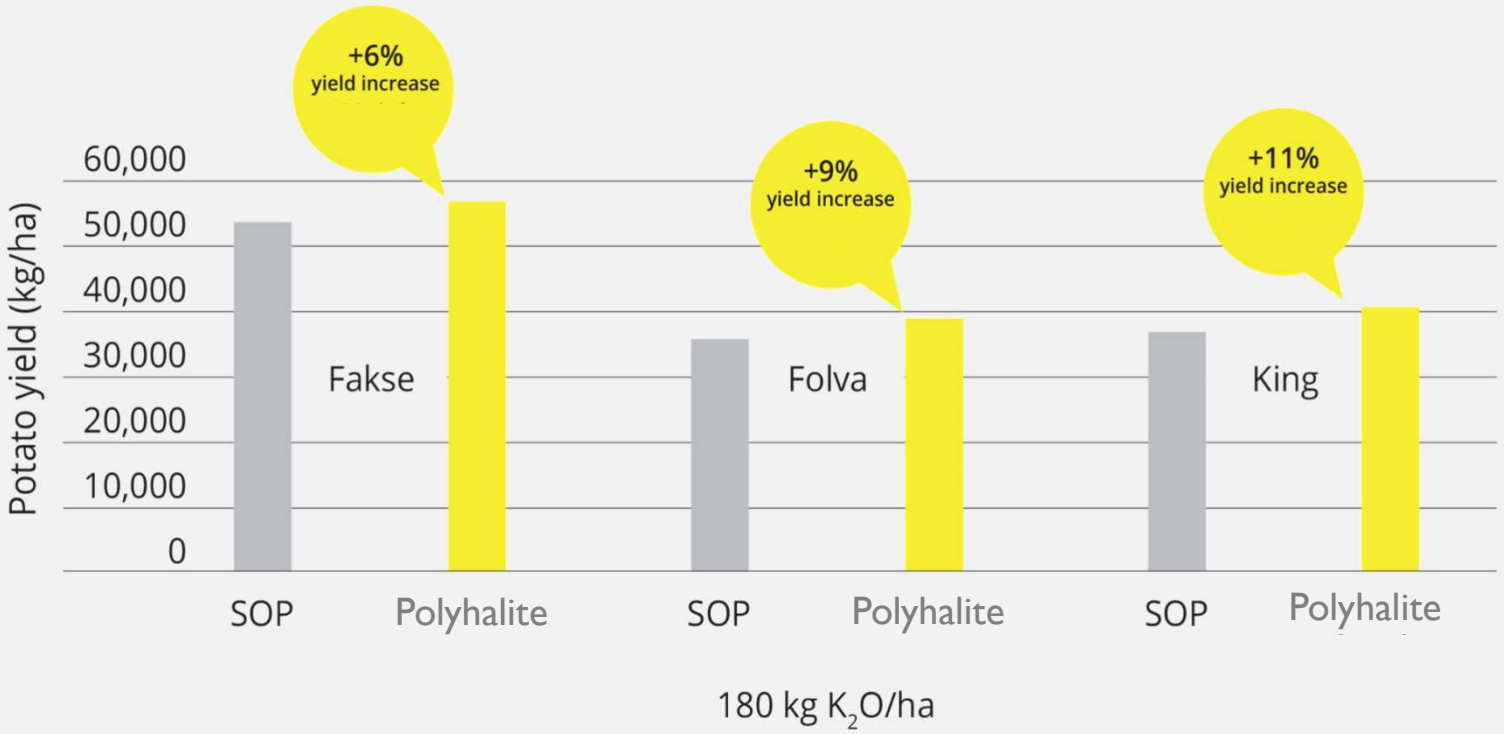
POTATO YIELDS OF THREE VARIETIES IN SWEDEN (2016)



Source: ICL trials

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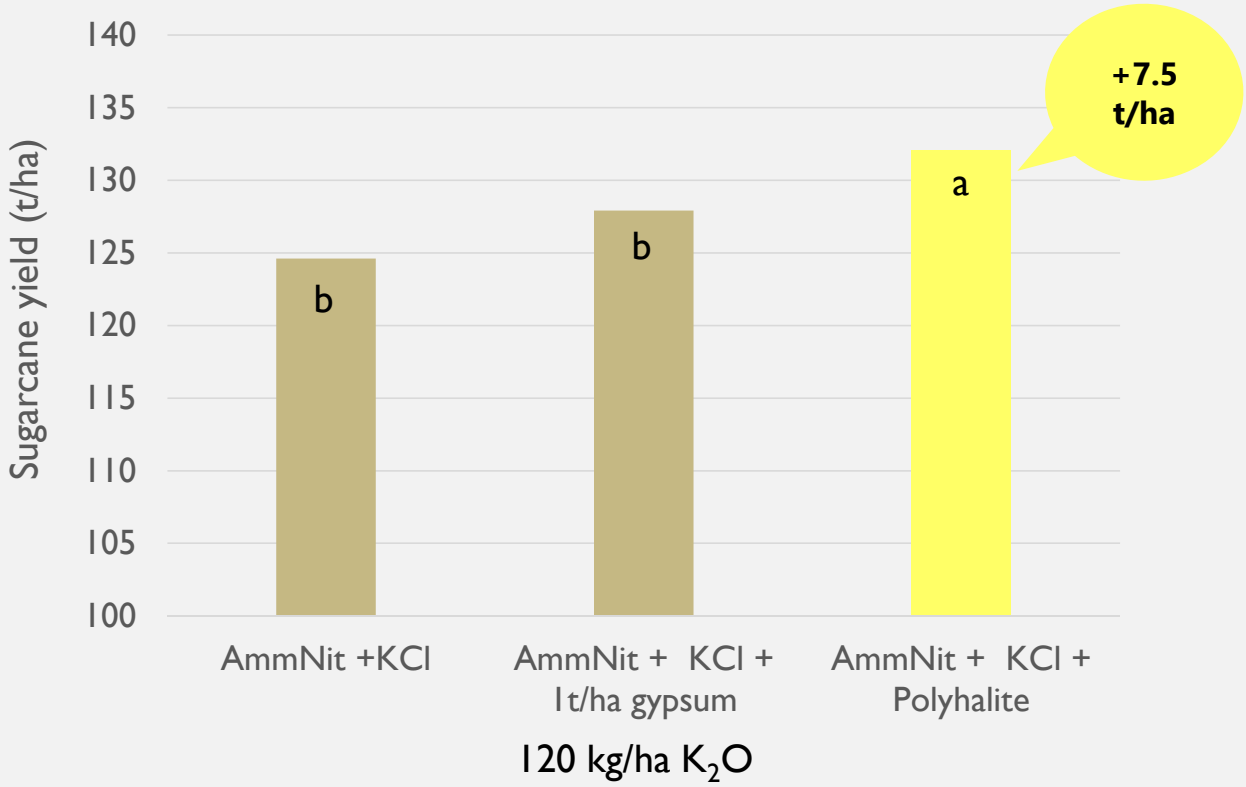
SUGARCANE YIELD IN BRAZIL CATANDUVA/SP, SEASON 2016/17



All treatments: 120 kg/ha N and 120 kg/ha K_2O. Fertilization in bands beside of the ratoons in emergency. AmmNit + KCl – blend 21-00-21, rate 550 kg/ha. Phosphogypsum supplied 150 kg/ha S and 190 kg/ha Ca, broadcast, one day before fertilization. Polyhalite supplied 32 kg/ha S, 20 kg/ha Ca, 6.5 kg/ha Mg and 24 kg/ha K_2O (in blend with AN and KCl). Blend 17-00-17 + 4.5% S + 3% Ca + 1% Mg, rate 680 kg/ha

Source: ICL trials

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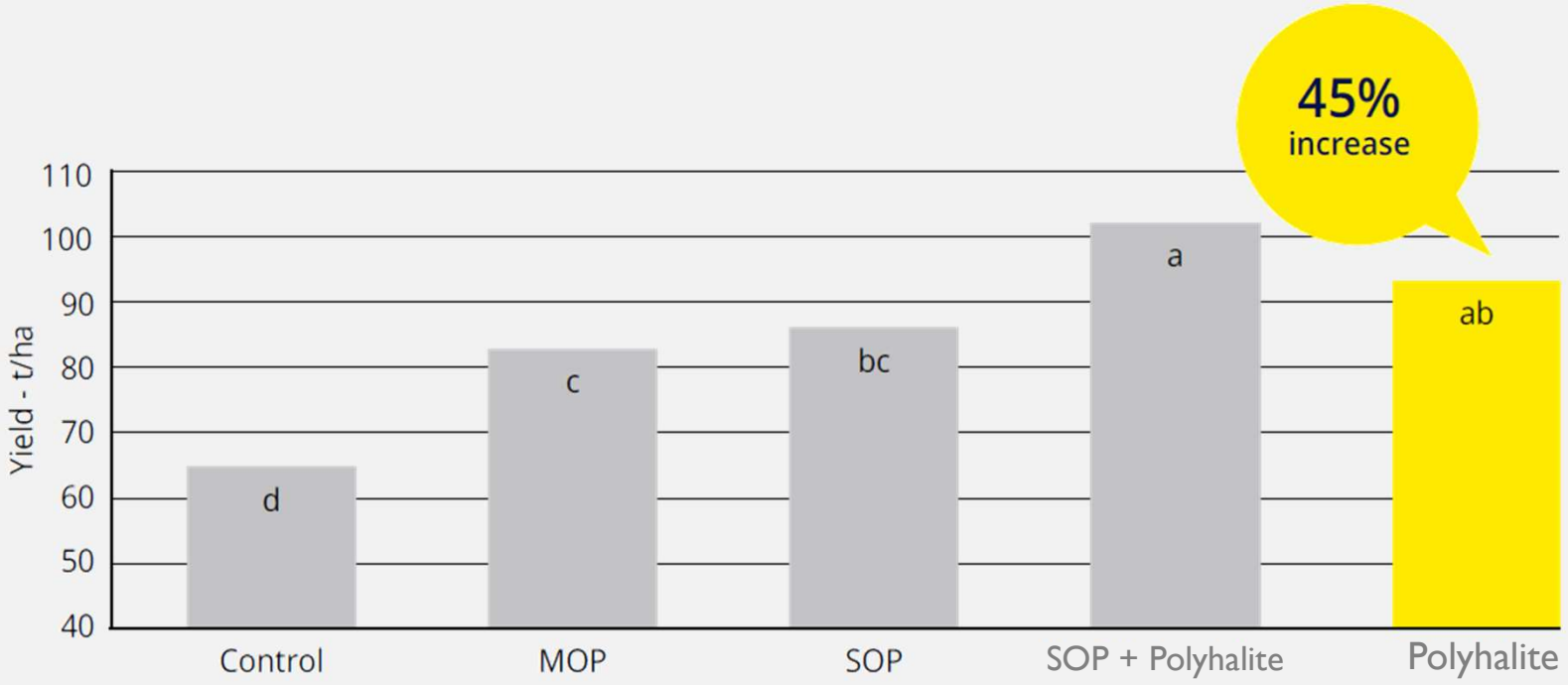
EFFECT ON CABBAGE YIELD ANTALYA, TURKEY (2016/17) EGE UNIVERSITY



300 kg/ha K_2O

Source: IPI e-ifc No. 56, March 2019, p. 14-40

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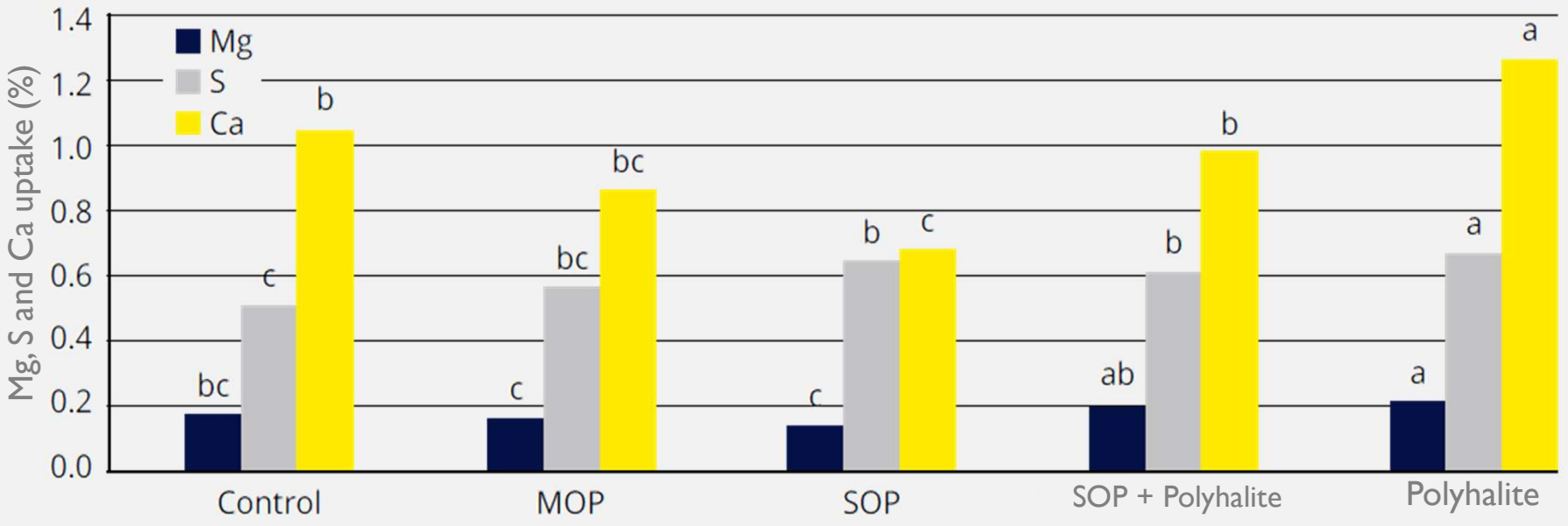
EFFECT ON CABBAGE NUTRIENTS' UPTAKE ANTALYA, TURKEY (2016/17) EGE UNIVERSITY



300 kg/ha K_2O

Source: IPI e-ifc No. 56, March 2019, p. 14-40

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QUALITY PROPERTIES OF ONION IN ANTALYA, TURKEY (2016/17) EGE UNIVERSITY

Treatments	Total soluble Solids (%)	Total Phenol (mg kg^{-1})	Vitamin C (mg 100 g^{-1})	Antioxidant Activity (%)
Control	6.75 c	161.05	7.40 c	14.28 b
KCl	7.55 ab	192.60	8.23 abc	28.81 a
K_2SO_4	7.95 a	190.10	7.73 bc	24.36 a
Polyhalite	7.80 a	185.70	9.08 a	25.48 a
K_2SO_4+ Polyhalite	7.35 b	181.60	8.50 ab	25.18 a
Significant level	***	ns	*	***
LSD	0.199	-	0.46	2.05

*: p≤0.05. ***: p≤0.001 ns: non-significant

270 kg/ha K_2O

Source: IPI e-ifc No. 53, June 2018, p.16-46

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QUALITY PROPERTIES OF ONION IN ANTALYA, TURKEY (2016/17) EGE UNIVERSITY

270 kg/ha K_2O

Source: IPI e-ifc No. 53, June 2018, p.16-46

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QUALITY PROPERTIES OF COTTON IN ANTALYA, TURKEY (2016/17) EGE UNIVERSITY

210 kg/ha K_2O

Source: IPI e-ifc No. 57, June 2019, p.17-47

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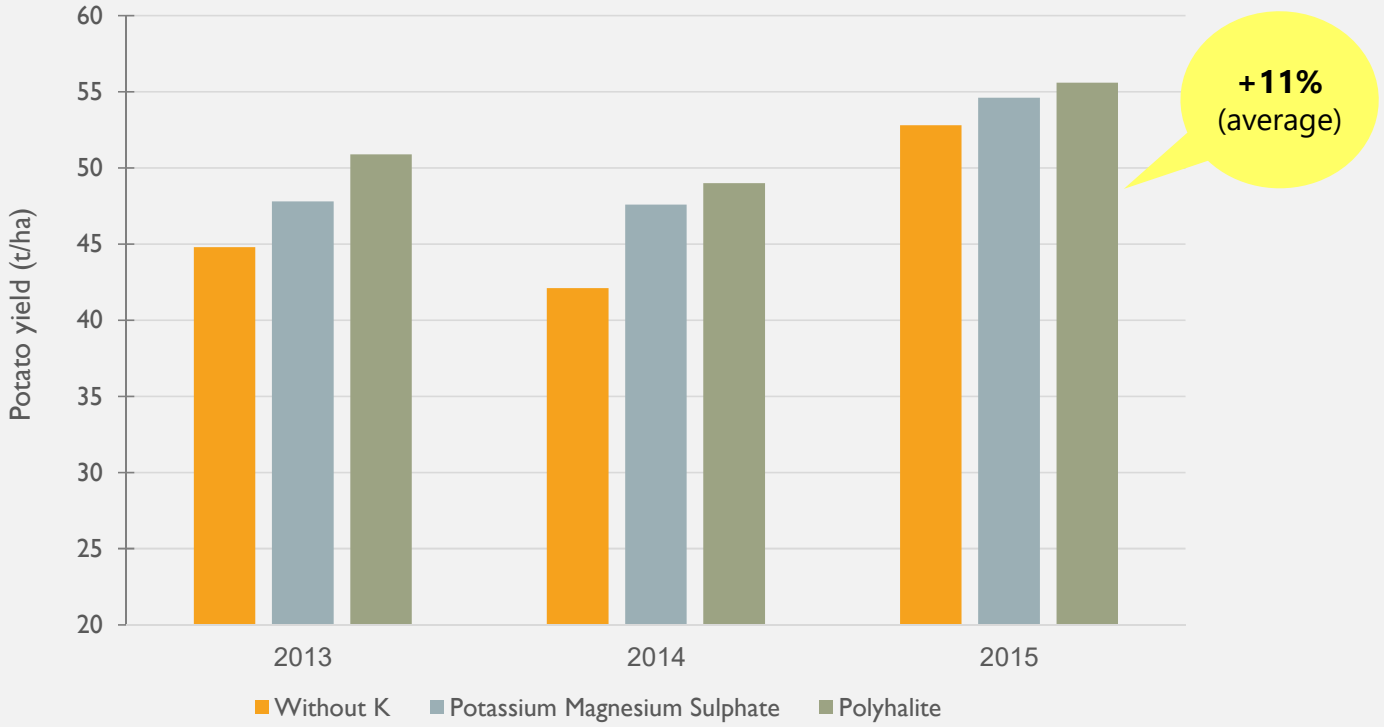
FIELD TRIAL ON POTATO IN HAMERSTORF, GERMANY 2013-15



240 kg/ha K_2O = 1,710 kg/ha Polyhalite

Source: Chamber of Agriculture Hannover Landwirtschaftskammer Niedersachsen

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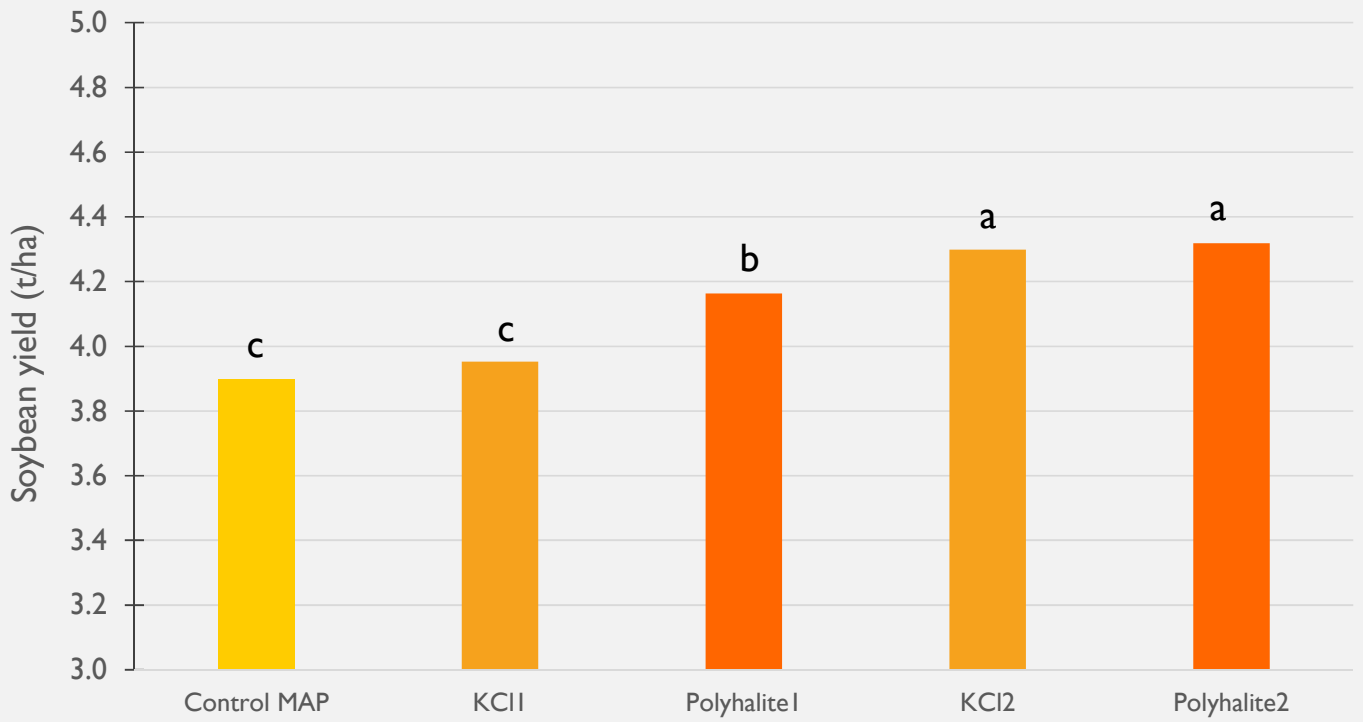
FIELD TRIAL ON SOYBEAN IN ITAPÚA, PARAGUAY 2017



Source: IPI e-ifc No. 55, December 2018

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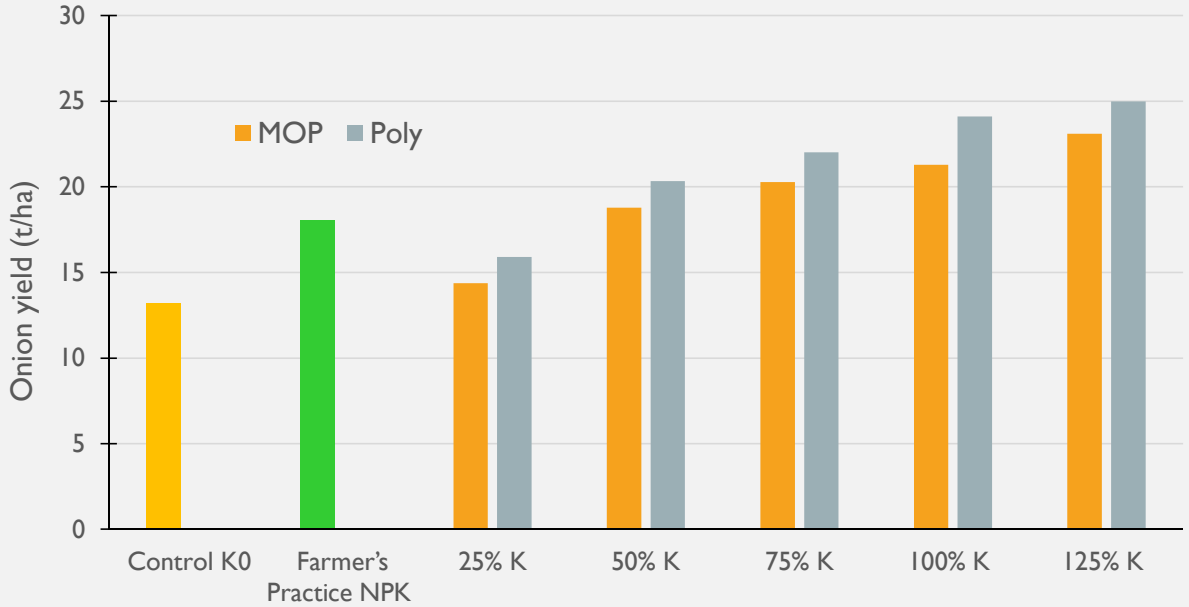
FIELD TRIAL ON ONION IN TAMIL NADU, INDIA 2018



Kg K_2O/ha	0	30	26.5	53	79.5	106	132.5

Source: IPI-TNAU ongoing trial

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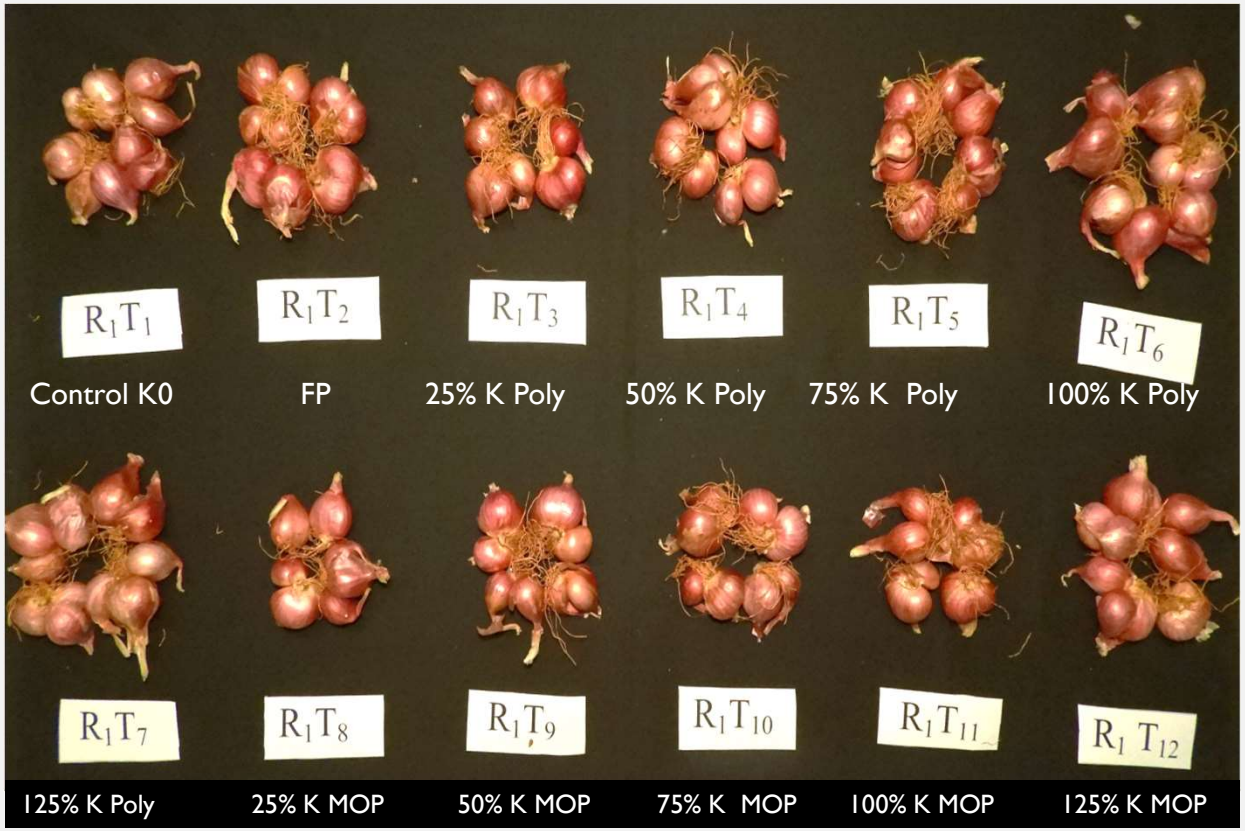
FIELD TRIAL ON ONION IN TAMIL NADU, INDIA 2018



Source: IPI-TNAU ongoing trial

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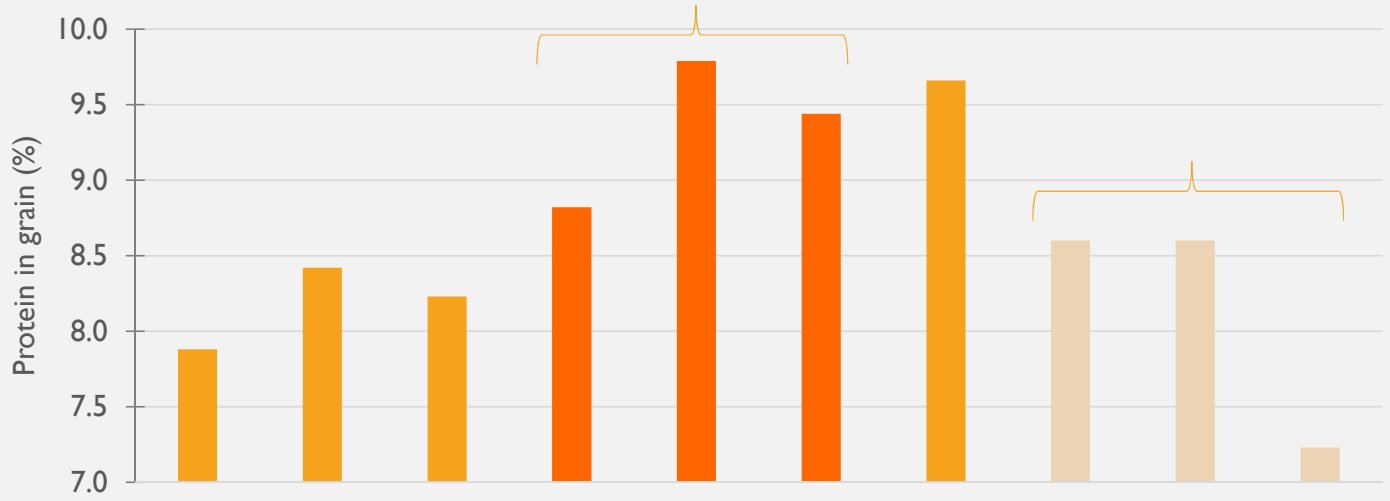
FIELD TRIAL ON MAIZE IN GUANAJUATO, MEXICO 2018



K_2O	0	K0	K50	K50	K50	K50	K28	K50	K50	K50
S	**0**	**0**	**0**	**6.5**	**13.1**	**26.1**	**52.2**	**13.1**	**26.1**	**52.2**
KCl	0	0	83	75	67	52	0	83	83	83
Poly	0	0	0	34	68	136	272	0	0	0
AmmSul	0	0	0	0	0	0	0	55	109	218

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Source: IPI-Inifap project

CONCLUSIONS

- Polyhalite is an excellent source of fully available sulphur, potassium, magnesium and calcium.
- Polyhalite is as soluble as other comparable fertilizers.
- Polyhalite has a low chloride, which gives multiple application options at no risks: furrow application, high doses, etc.
- Less prone to leaching losses, preserving the environment. Effective even in high leaching soils.
- Polyhalite has a prolonged release pattern throughout the crop cycle, matching the crop needs.
- **Proved as an effective of K, due to its relatively low K content, it can be combined with other K sources (MOP, SOP) thus supplying S, Mg and Ca.**

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