

Polyhalite - a new multi nutrient fertilizer with sulphur, potassium, magnesium and calcium

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ICL Fertilizers

13th Dahlia Greidinger
International Symposium 2019
Technion, Haifa, Israel



What is polyhalite?

Polyhalite is a sulphate-based mineral formed during the evaporation of prehistoric seas

It is a natural mineral from underneath the North Sea close to the UK coast that contains four nutrients

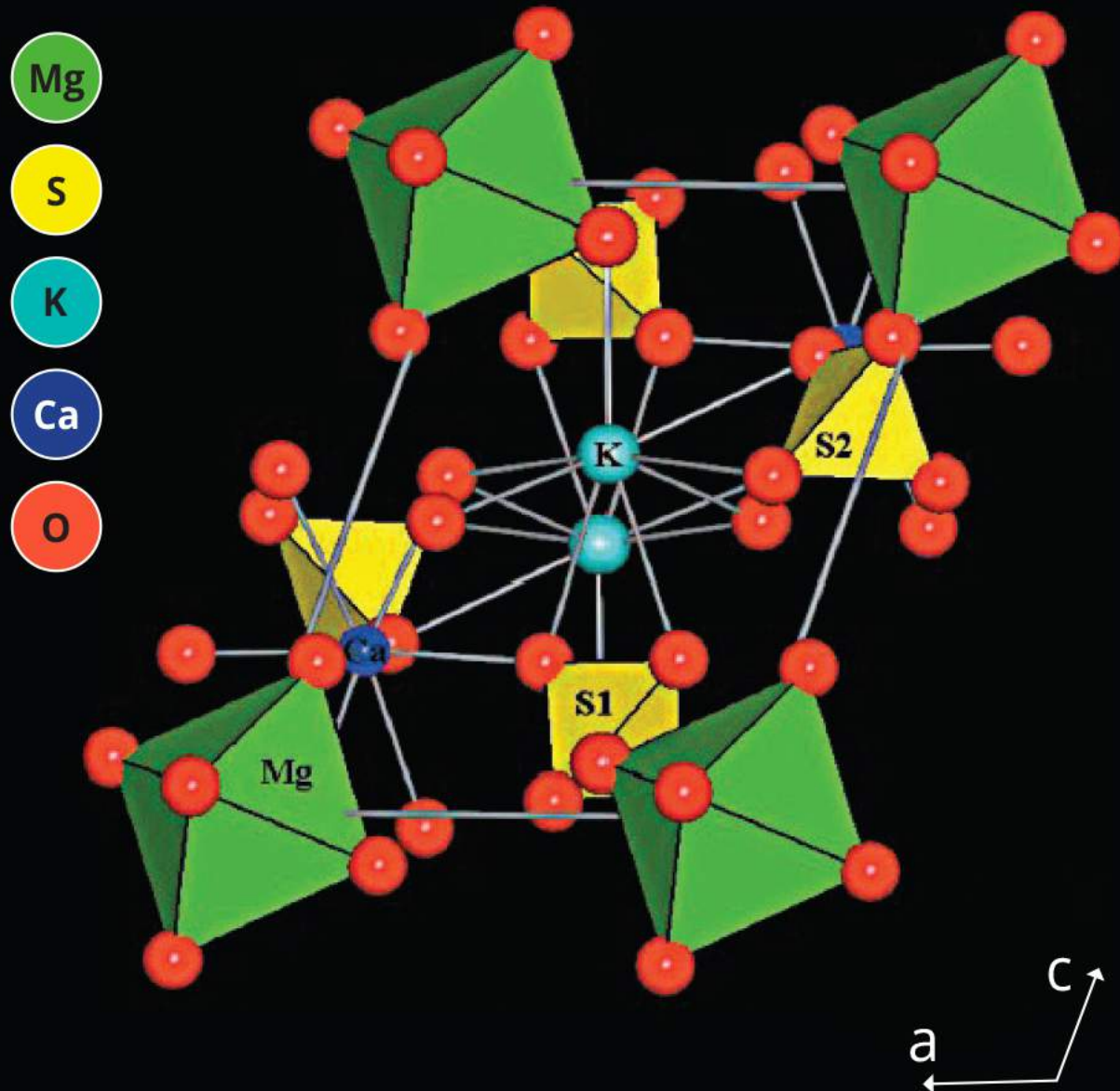


The first polyhalite mine in the world

The first and only polyhalite mine in the world is in England and it is estimated to have around 1 billion tons of polyhalite reserve



The crystal structure of polyhalite



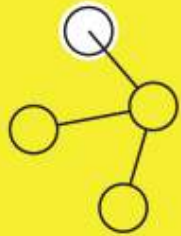
Polyhalite is a mineral, not a mixture of salts



ONE single complex crystal

Reinvestigation of polyhalite, $\text{K}_2\text{Ca}_2\text{Mg}(\text{SO}_4)_4 \cdot 2\text{H}_2\text{O}$
Luca Bindi; Acta Crystallographica Section E Structure
Reports Online / ISSN 1600-5368. Editors: W. Clegg and D.
G. Watson

What nutrients does polyhalite provide?



S

48% SO₃
(19.2% S)

As sulphate

An essential constituent of all proteins



K

14% K₂O
(11.6% K)

As potassium sulphate

Secures yield and quality



Mg

6% MgO
(3.6% Mg)

As magnesium sulphate

For high photosynthesis



Ca

17% CaO
(12.2% Ca)

As calcium sulphate

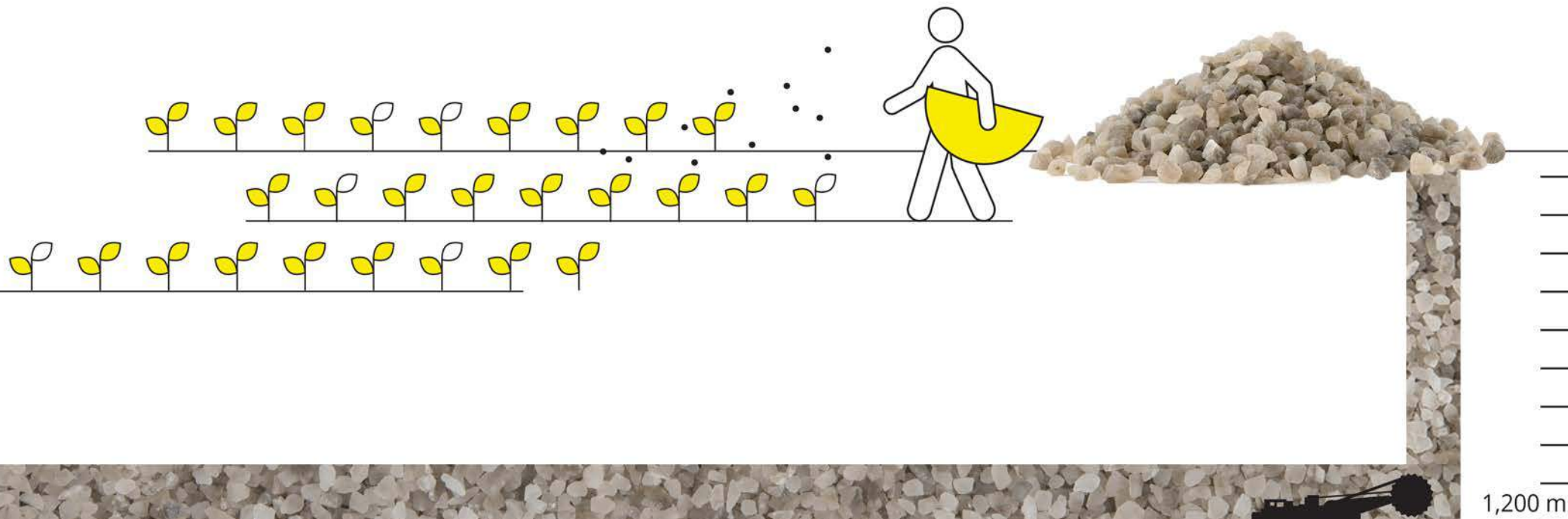
For strong and healthy crop

The polyhalite production process

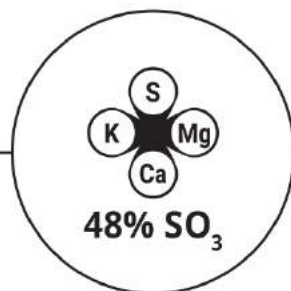
Polyhalite is simply mined, crushed, screened, loaded and shipped worldwide.

There are no chemical processes.

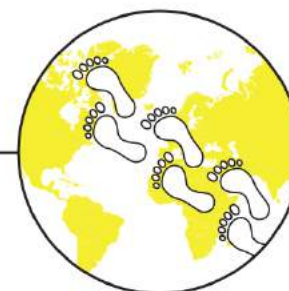
It is ready to use straight from the mine on farmers' fields.



Polyhalite is natural



a pure, natural product without any added chemicals

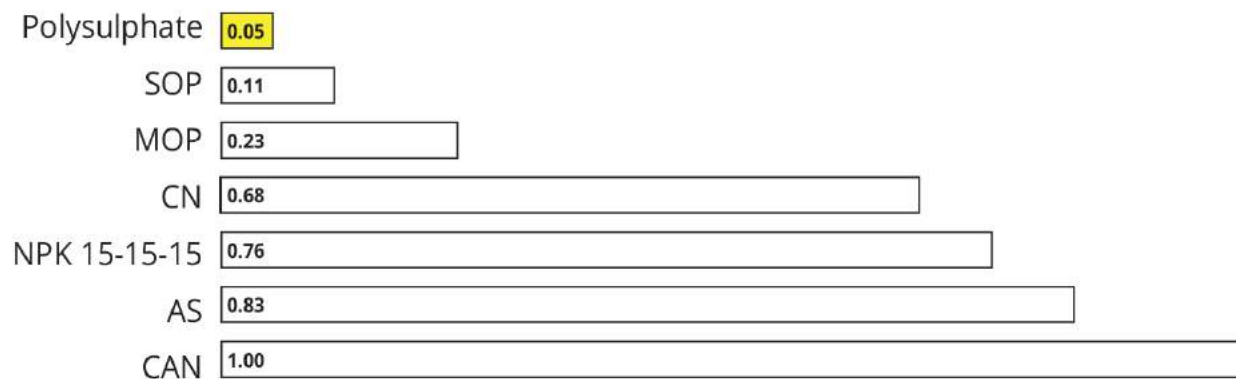


with a low carbon footprint



approved for use in organic agriculture

Carbon footprint in leading products ($\text{kg CO}_2 \text{ eq} / \text{kg product}$)



The calculation has been completed using IPCC, 2007 emission factors, by Filkin & Co. EHS Limited



Polyhalite approved for use in organic agriculture

- ▶ Concentrated organic product
- ▶ Easy to handle comparing to organic materials
- ▶ Can be applied as an enrichment for soil conditioners



US, Canada



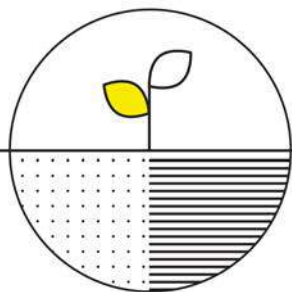
European Union



UK, Italy, Germany, Israel, Netherlands



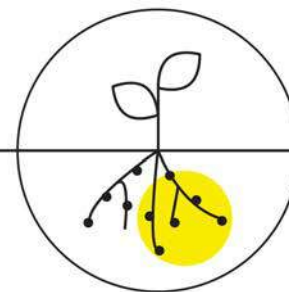
Polyhalite is versatile



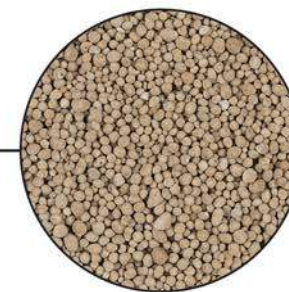
suits all crops
and soil types



standard size,
granules or
mini granules



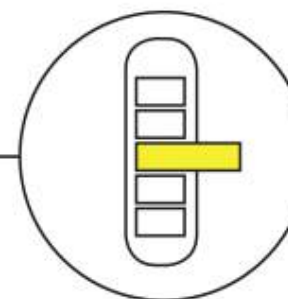
fully soluble
releasing the
nutrients for
plant uptake



for direct
application,
bulk blending
and compound
fertilizers



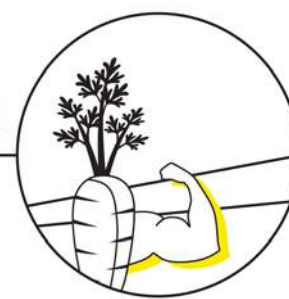
ideal for
chloride-
sensitive crops



low salt index
and neutral
pH



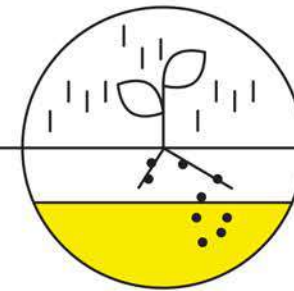
easy to use
and spreads
well



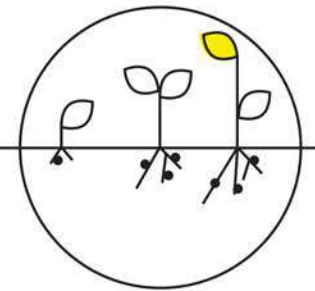
enhances crop
health and
strength



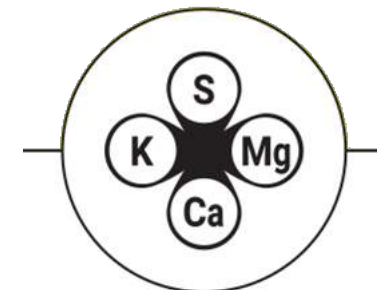
Polyhalite has prolonged availability of nutrients



better for the environment
- less risk of leaching



better for crops as get nutrition as needed

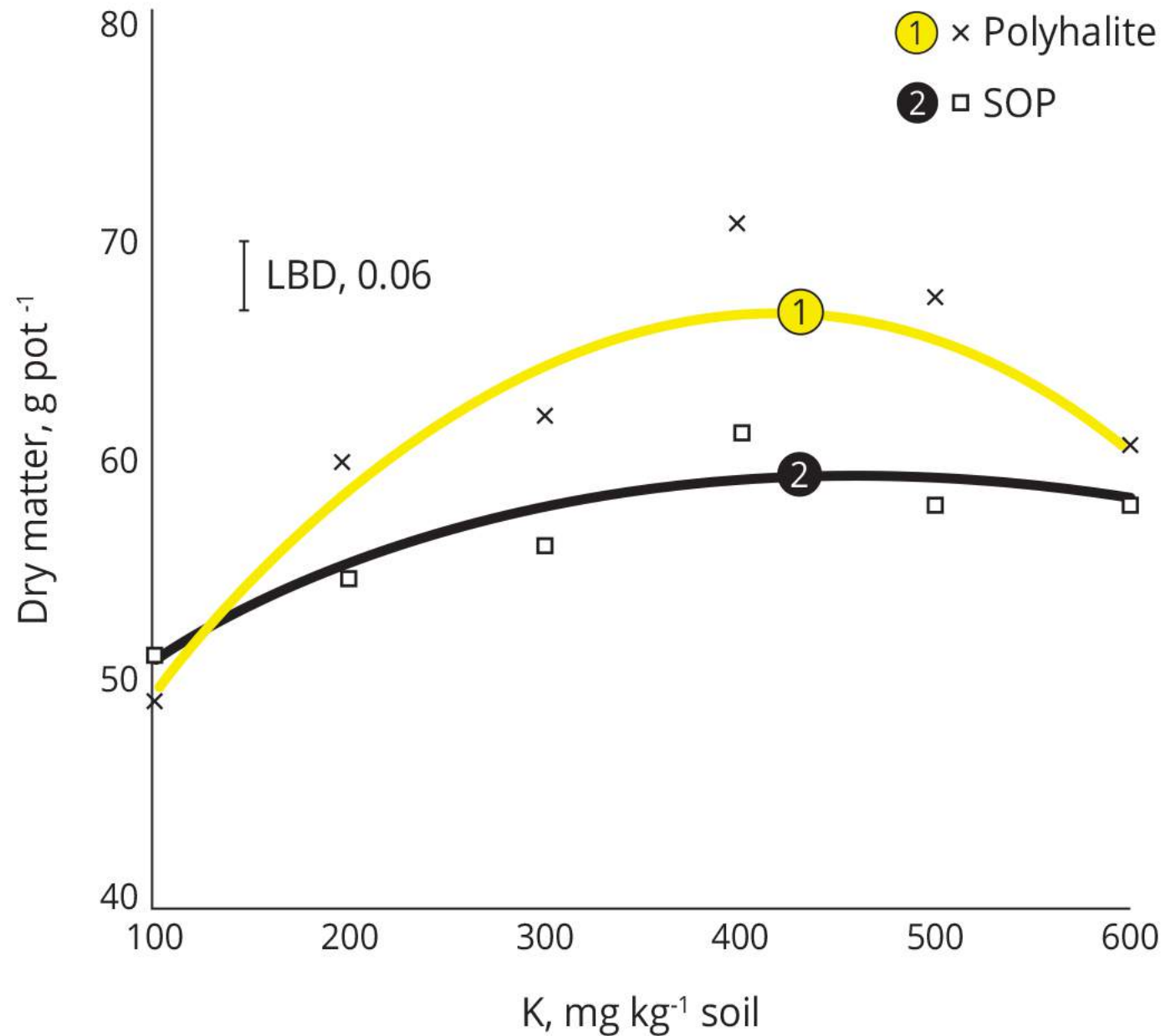


Residual effect for next crop



Polyhalite application to sorghum-sudangrass and leaching in soil columns

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



0038-075X/91/1512-0159\$03.00/0
SOIL SCIENCE
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February 1991
Vol. 151, No. 2
Printed in U.S.A.

POLYHALITE APPLICATION TO SORGHUM-SUDANGRASS AND
LEACHING IN SOIL COLUMNS

K. A. BARBARICK¹

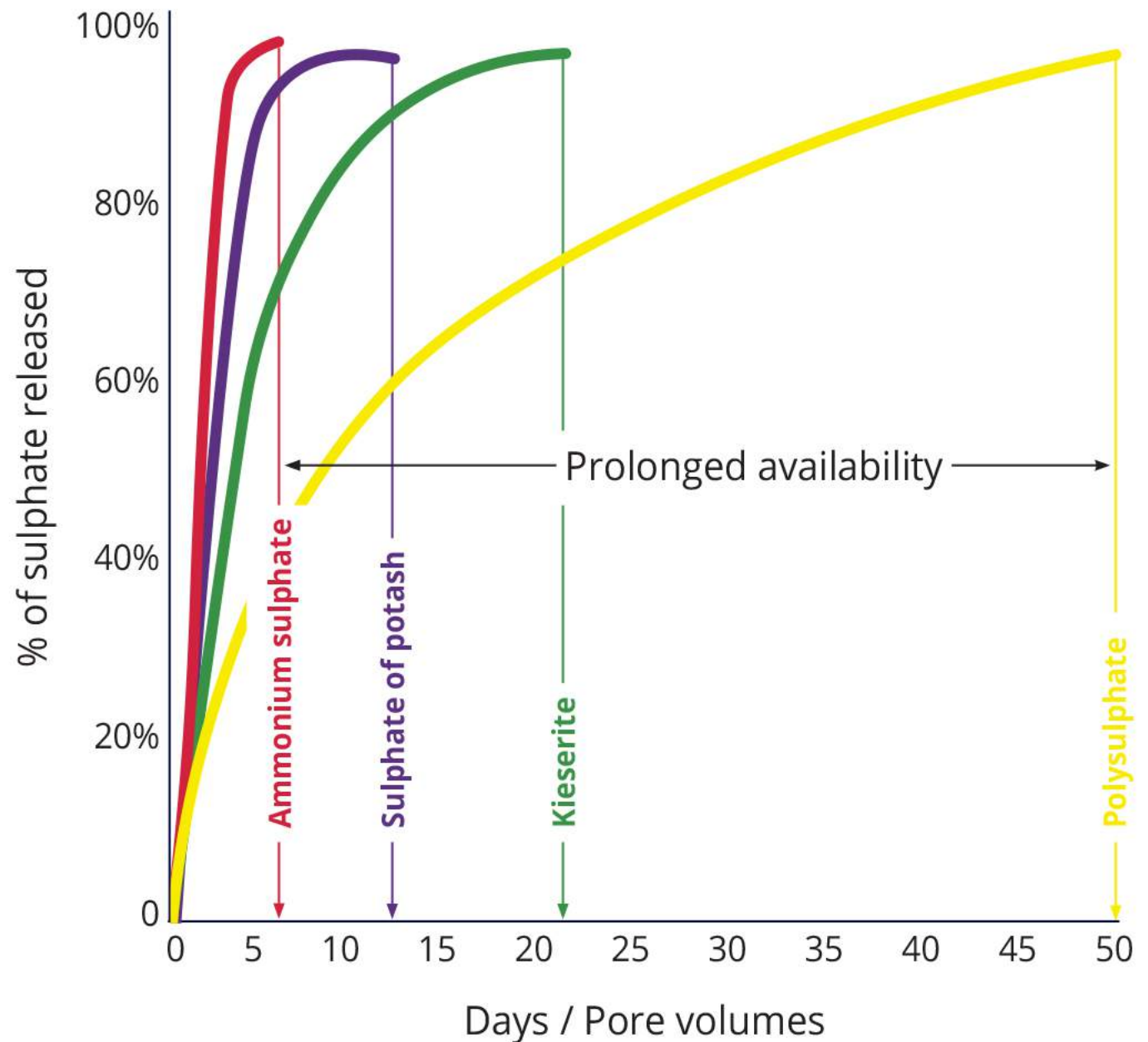
izer treatments. In these studies, finely-ground polyhalite provided adequate K, Ca, Mg, and $\text{SO}_4\text{-S}$ to the plants and performed **somewhat like a slow-release fertilizer compared to more soluble fertilizer sources.** This mineral should be an effective fertilizer in acid, infertile soils.

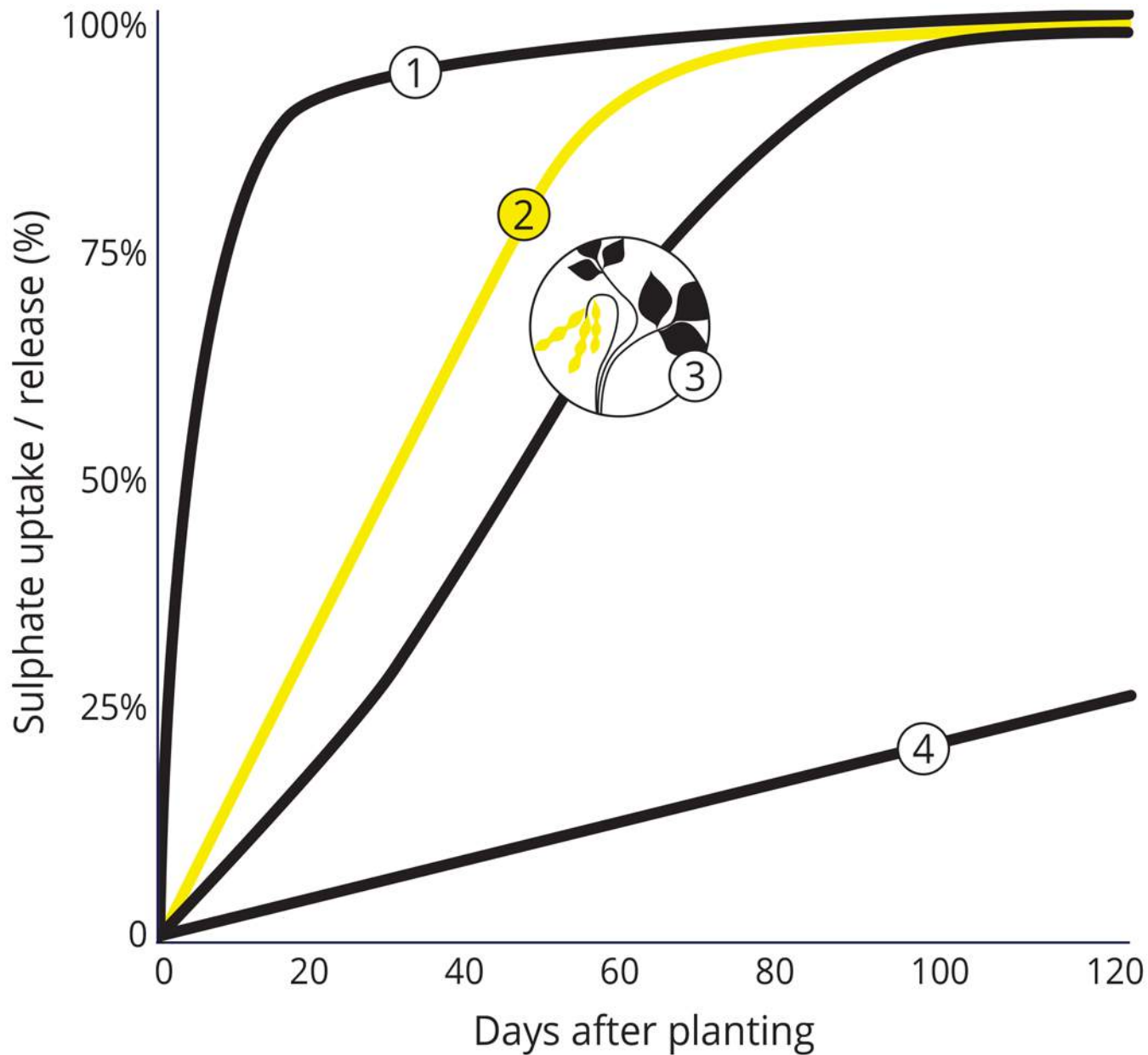
Evidence of how Polyhalite releases sulphur over time

Release of sulphate - Polyhalite vs. other sources (granular grades)

University of Nottingham, UK

Presented at the 2017 IFS Agronomic Conference, Cambridge, UK



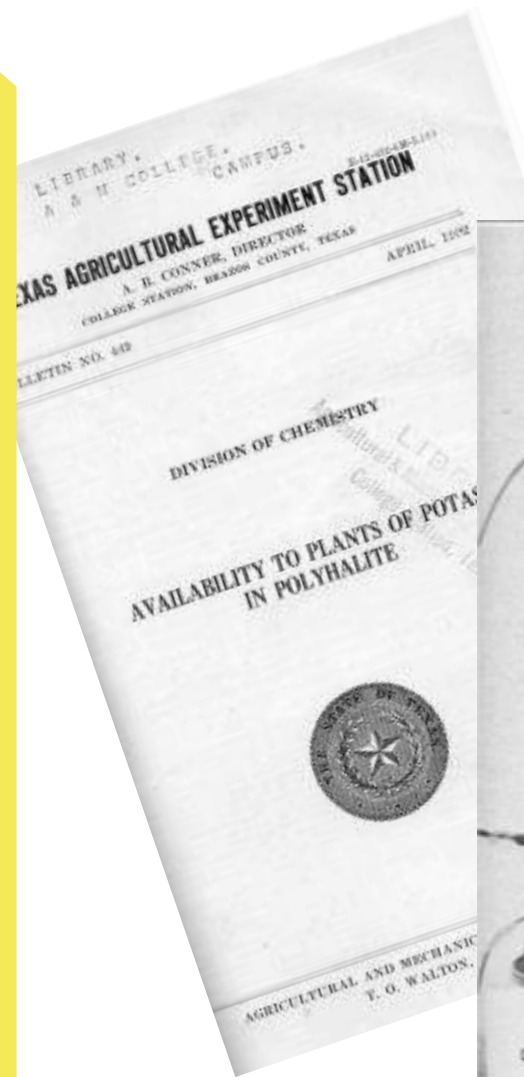


Polyhalite's sulphur release meets crop demand

Optimal match between S release from Polyhalite and its uptake by the crop

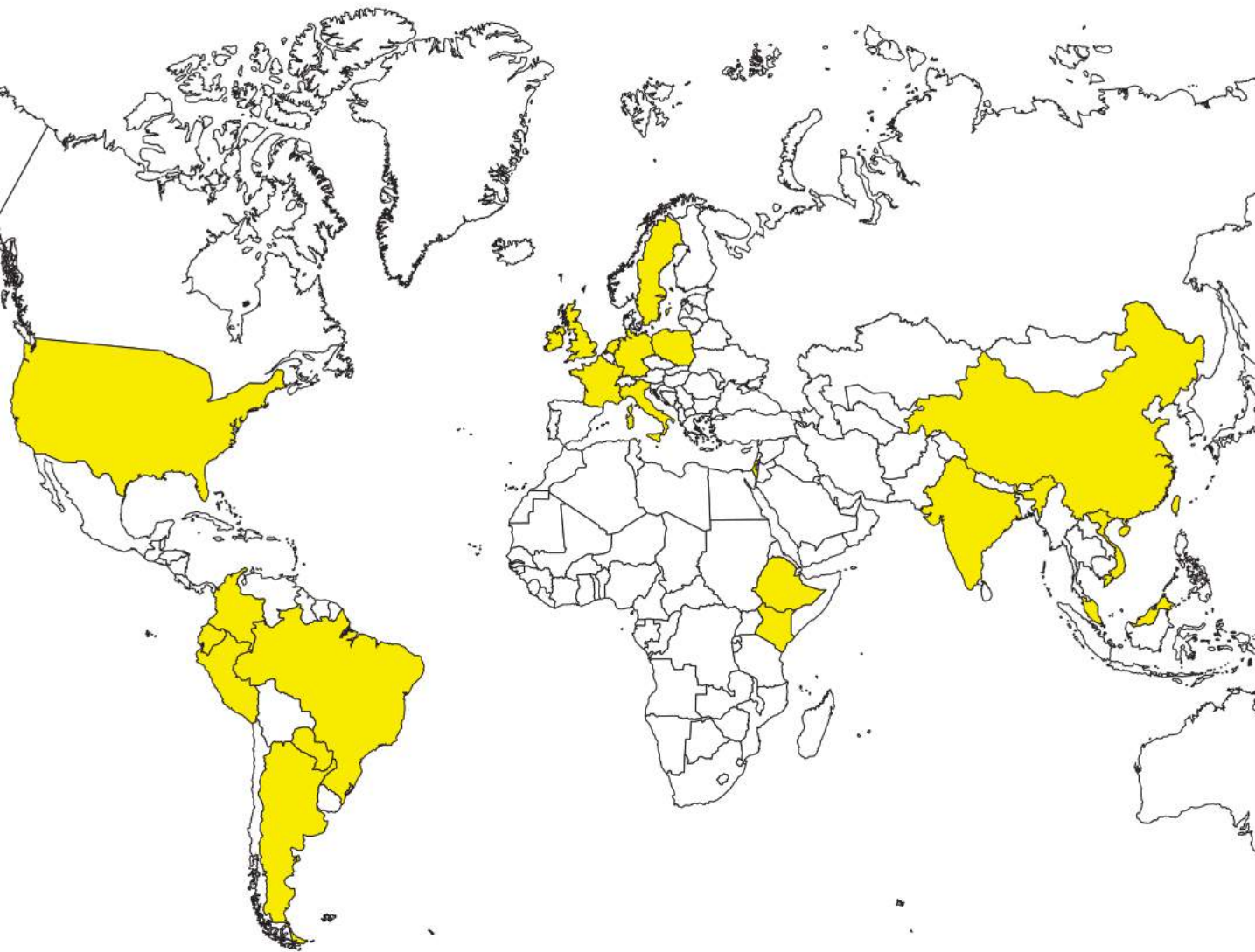
- ① Sulphate released from ammonium sulphate or from SOP
- ② Sulphate released from Polyhalite
- ③ S uptake by soybean crop
- ④ Sulphate released from CaSO₄ (gypsum)

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.

Polyhalite around the world



Research on five continents is showing that these major crops all benefit from Polyhalite fertilizer

- | | | |
|-------------|------------|--------------|
| alfalfa | garlic | rapeseed |
| apple | ginger | rice |
| banana | grape | rocket salad |
| barley | mustard | rye |
| broccoli | Leaf | sesame |
| cabbage | vegetables | soybean |
| carrot | maize | strawberry |
| cauliflower | melon | sunflower |
| cherry | oil palm | tea |
| citrus | onion | tobacco |
| coffee | pasture | tomato |
| cotton | peas | wheat |
| cut flowers | pineapple | |
| Fodder | pomelo | |
| crops | potato | |

37
crops

23
countries

Polyhalite trials around the world

China



With polyhalite



Without polyhalite

China



With polyhalite



Without polyhalite

Malaysia



With polyhalite



Without polyhalite

Sweden



With polyhalite



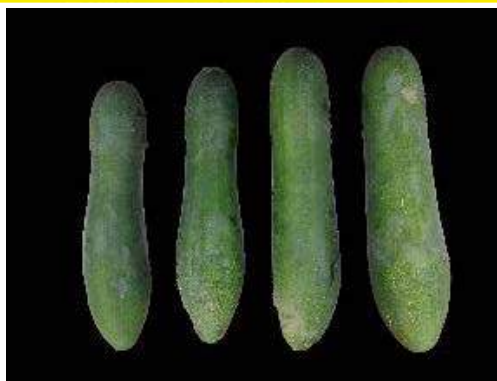
Without polyhalite

Polyhalite trials around the world

China



With polyhalite



Without polyhalite

Israel



With polyhalite



Without polyhalite

UK



With polyhalite



Without polyhalite

Malaysia



With polyhalite



Without polyhalite



CFPN

Regions

Israel

Concept

Basic detailed research



Universities

US, UK
Malaysia,
China

Work with research



IPI

China, LAM
India, Vietnam
East Africa

Work with partners



Demonstrations

In all markets

Bring to farmers

Agronomic effects by polyhalite

S effect (residual effect)

K effect

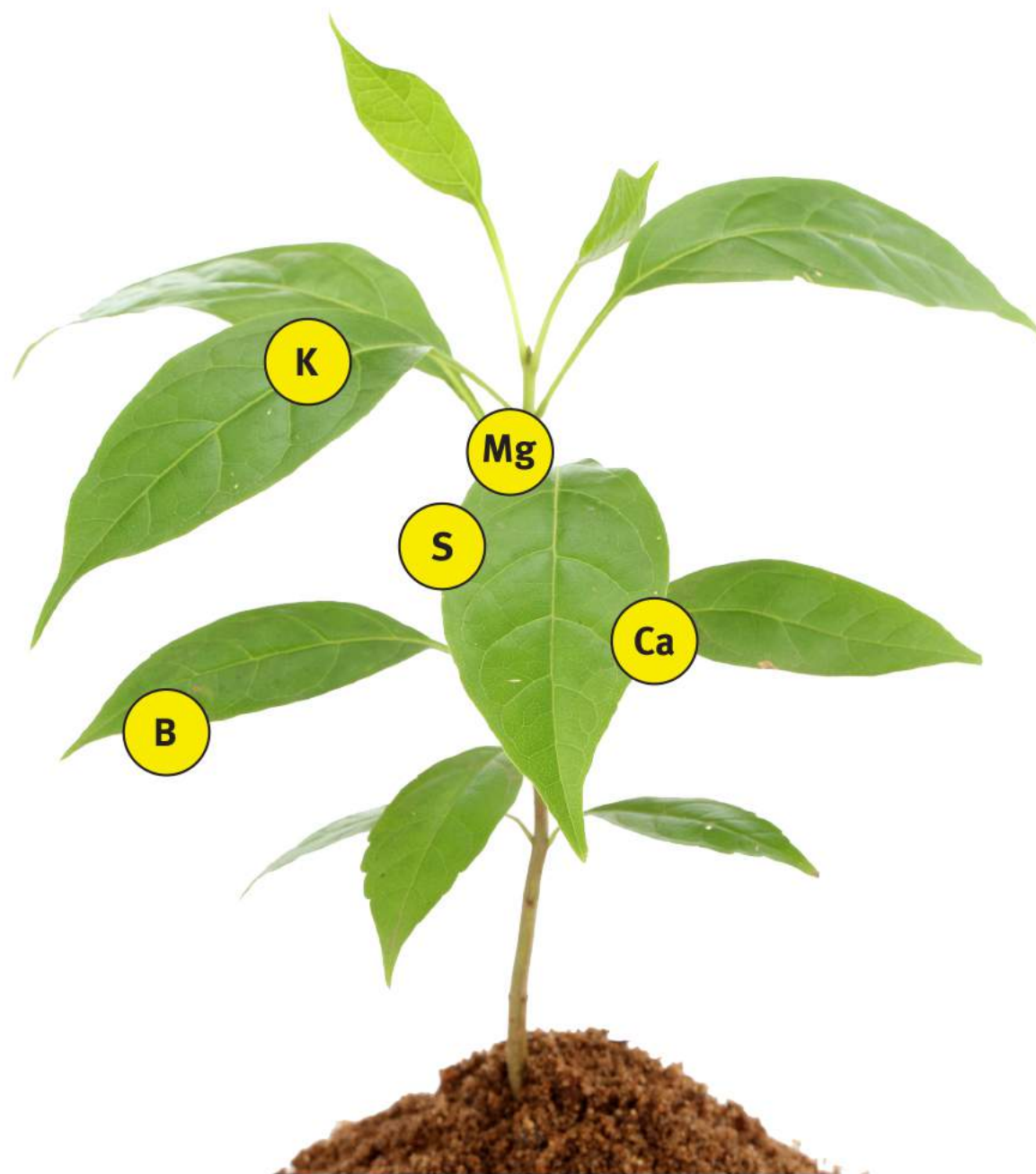
Mg effect

Ca effect

B effect

Solubility and the
'extended availability'

Salinity / sodicity
alliviation



Sulphur

S

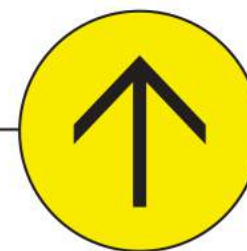


Soybean trial in Brazil

Effect of polyhalite as a source of sulphur for soybean in Brazil's Cerrado region (2016/17)

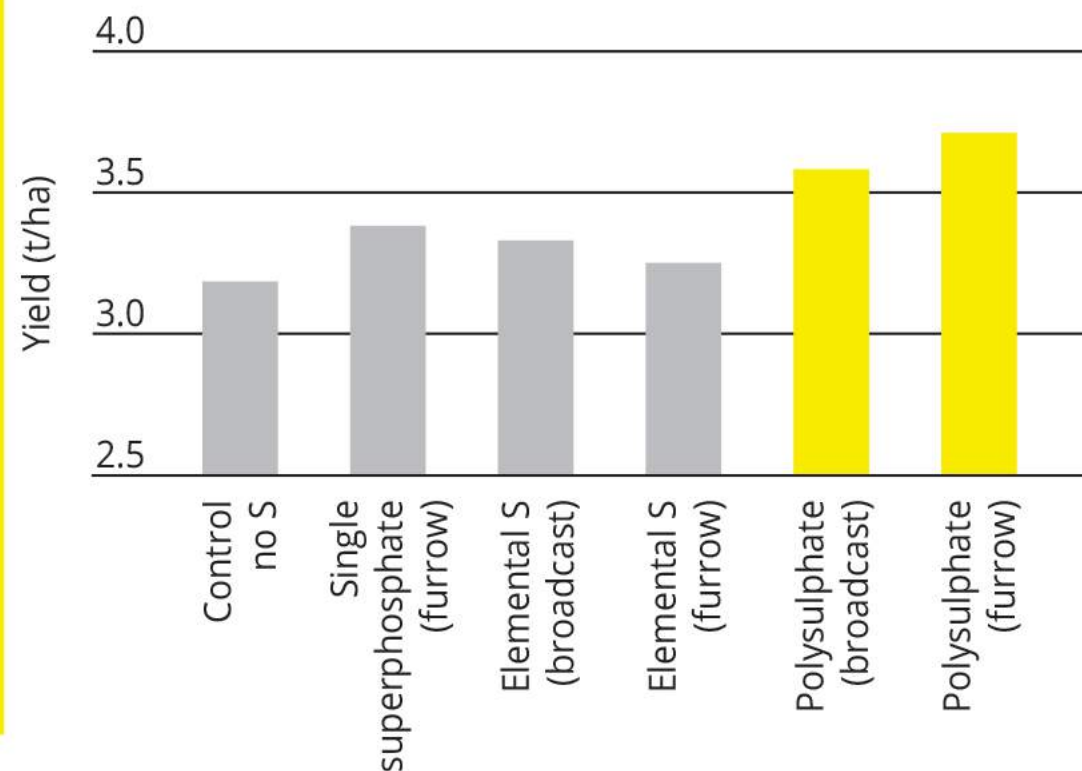
Results

- Polyhalite is a highly viable source of sulphur for soybean fertilization.
- Polyhalite in furrow increased soybean yield by 16% compared with fertilization without sulphur.
- Polyhalite in furrow increased soybean yield by 9.6% compared with single superphosphate.
- A yield improvement of 14% was recorded with polyhalite in furrow as compared with pastilled elemental sulphur.



Yield increase of
16%

compared with control treatment (no S)



Roots

Ca





Peas trial

Northern R&D station
in Israel (acidic soil)

Better root
development

with polyhalite –
effect of calcium



Generic NPK
15-15-15



NPK with
polyhalite
15-15-15



Generic NPK
15-4-14



NPK with
polyhalite
12-8-10



Better root development

with polyhalite –
effect of calcium

Garlic trial

China



With
polyhalite



Root development of soybean in Brazil

Yield increase of
18%

Additional income of
253 USD/ha



With polyhalite



Without polyhalite

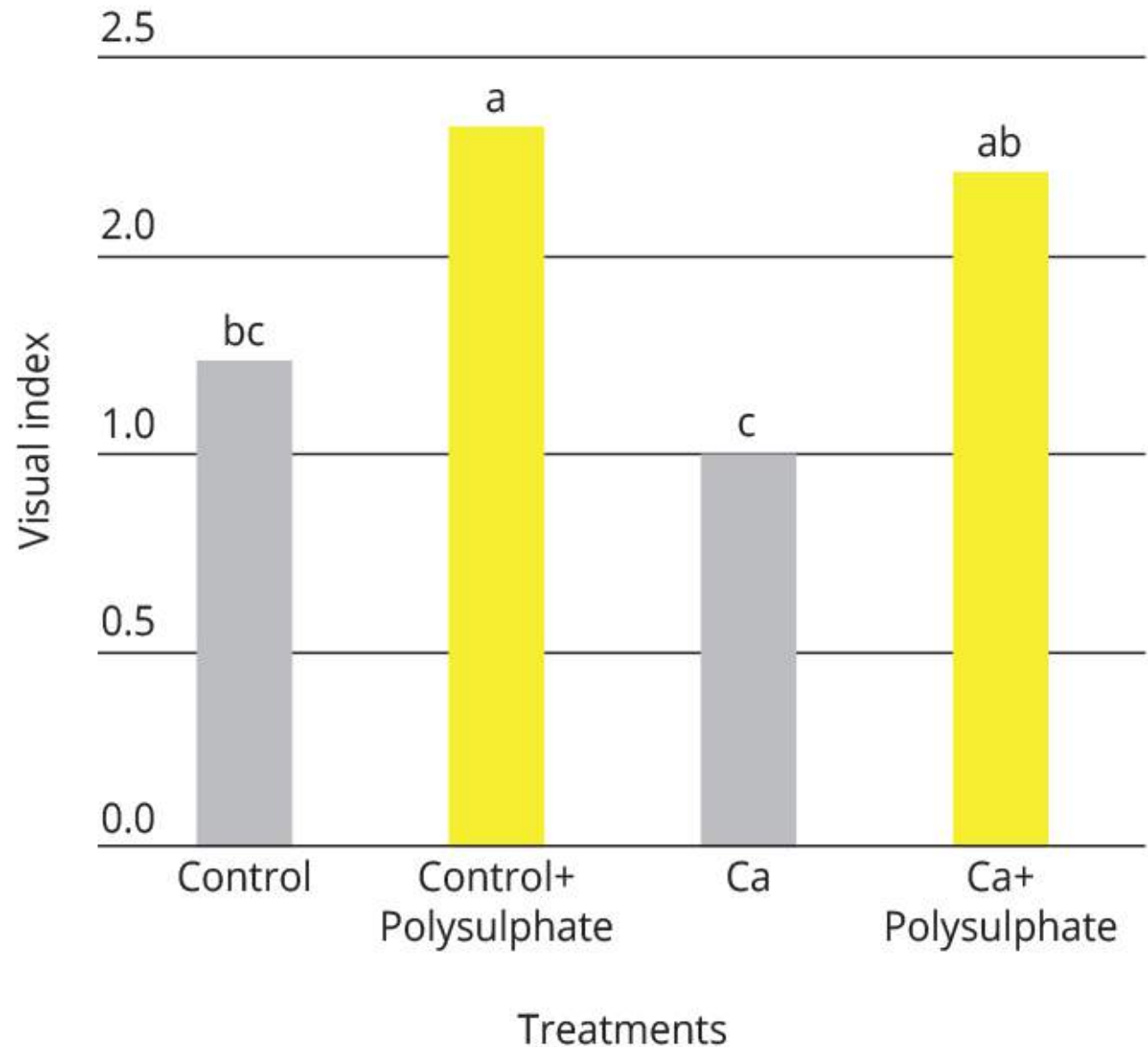


Longer shelf life polyhalite fertilization - the effect of calcium on skin quality of potato

(a CFPN project)

Application of polyhalite
at the end of the growth

Cv Arizona, 2016



* Control = Same nutrient content from traditional fertilizers

Nutritional
quality

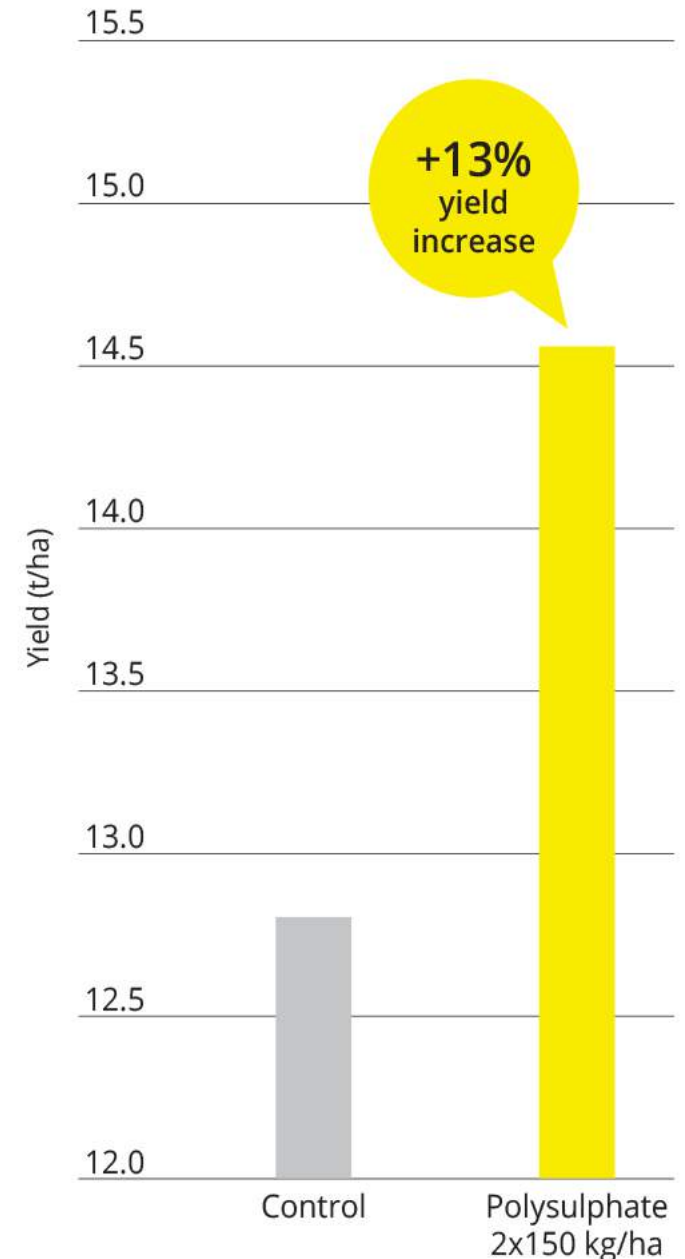
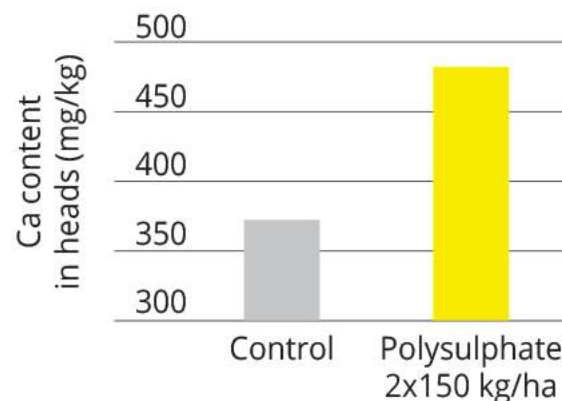
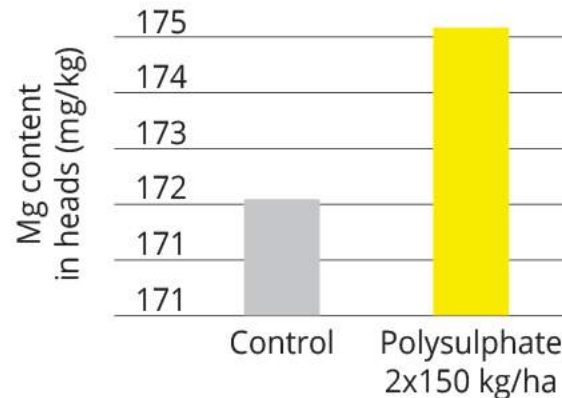
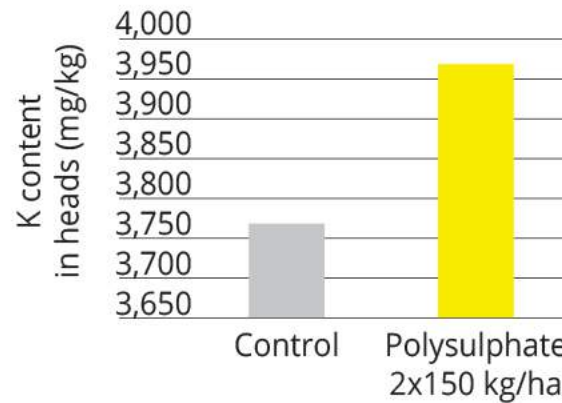


Increasing valuable nutrients in food

Broccoli trial in France (2016)

Results

- Polyhalite improved yield by 13% over the control.
- Polyhalite increased head size from 534 g in the control to 604 g
- Potassium, Mg and Ca content in the heads increased by 5%, 1.7% and 23% respectively compared to the control.



* Control = Same nutrient content from traditional fertilizers



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 ₂ SO 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 ₂ SO 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

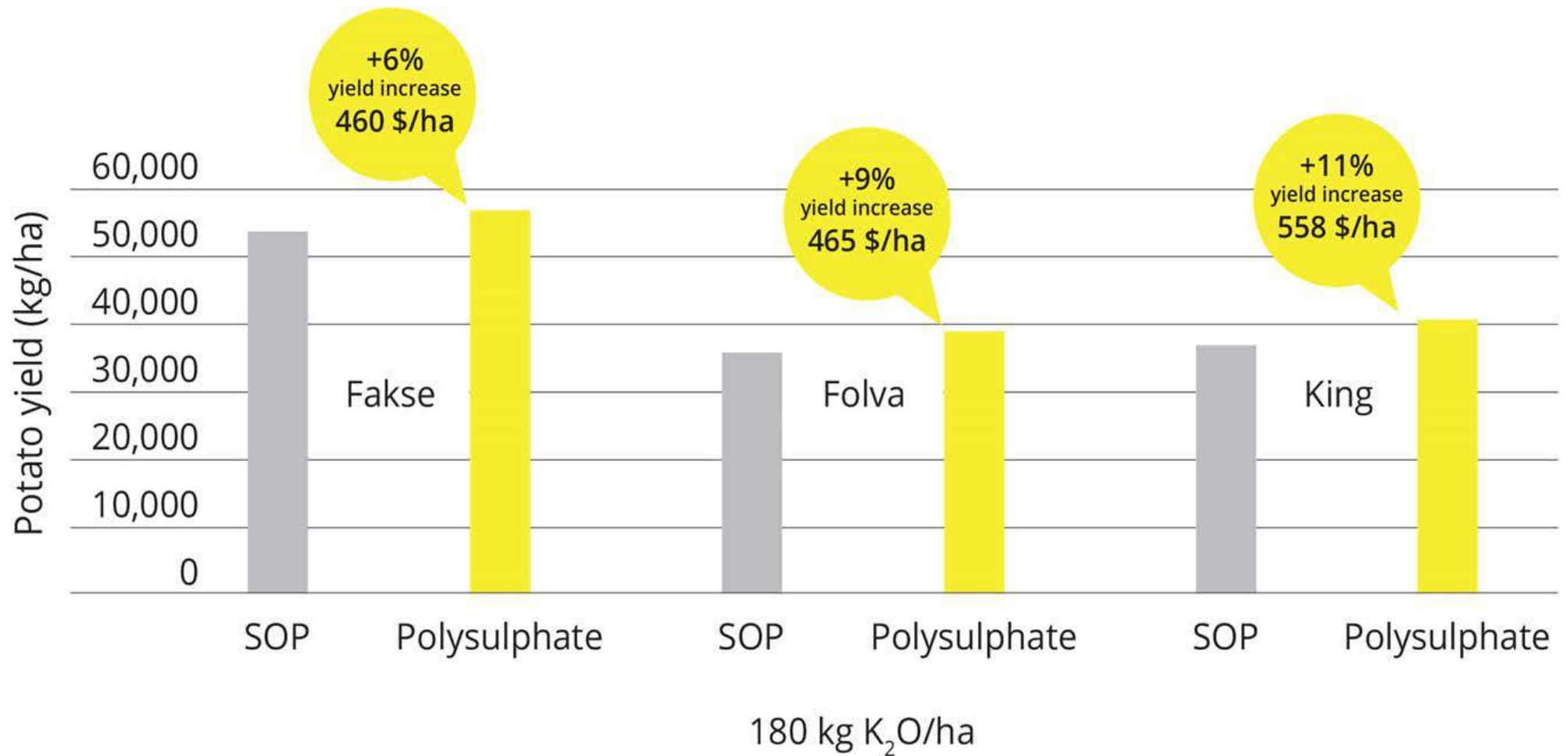
Potassium

K



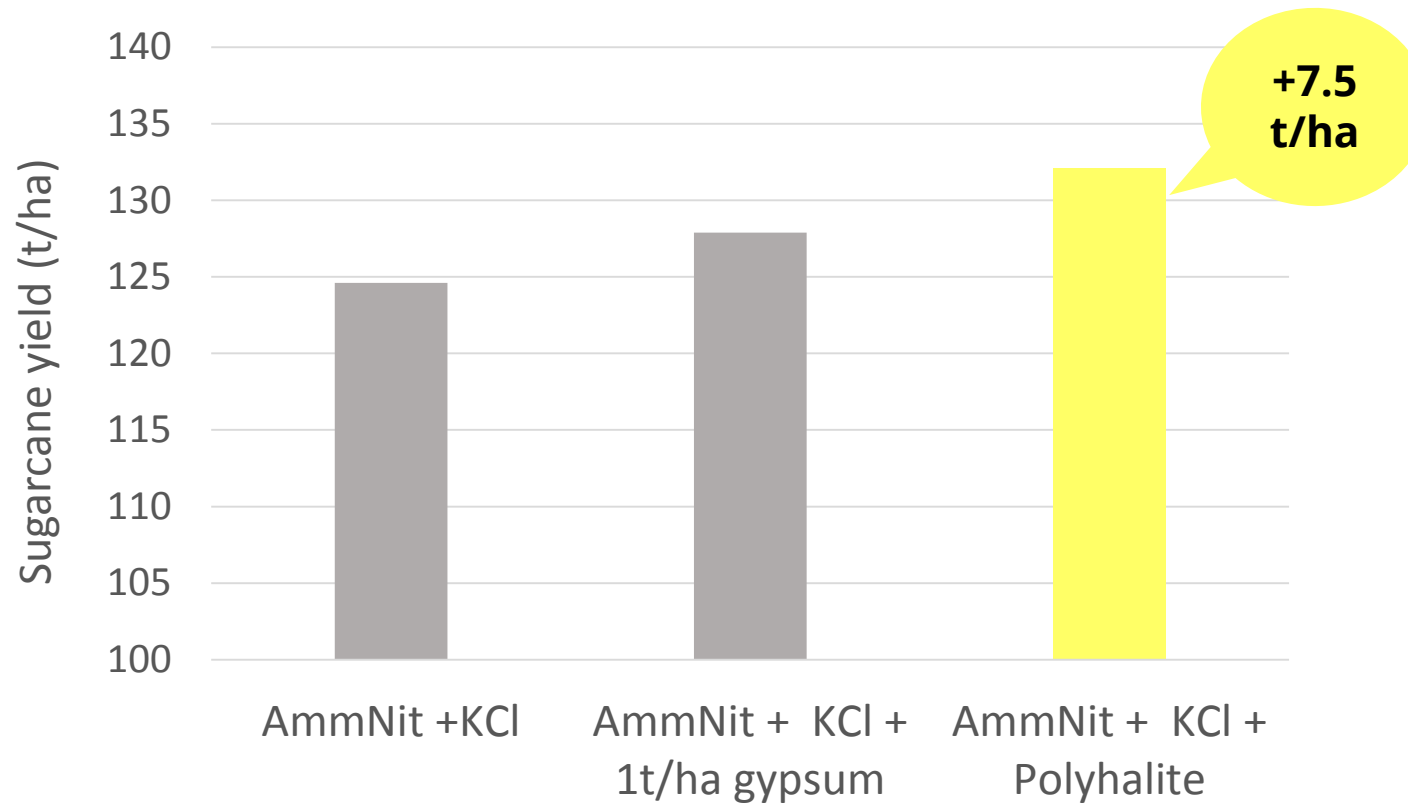


Potato yields of three varieties in Sweden (2016)






Sugarcane yield in Brazil Catanduva/SP, season 2016/17 3^o harvest



All treatments: 120 kg/ha N and 120 kg/ha K₂O. 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 K₂O (in blend with AN and KCl). Blend 17-00-17 + 4,5% S + 3% Ca + 1% Mg, rate 680 kg/ha

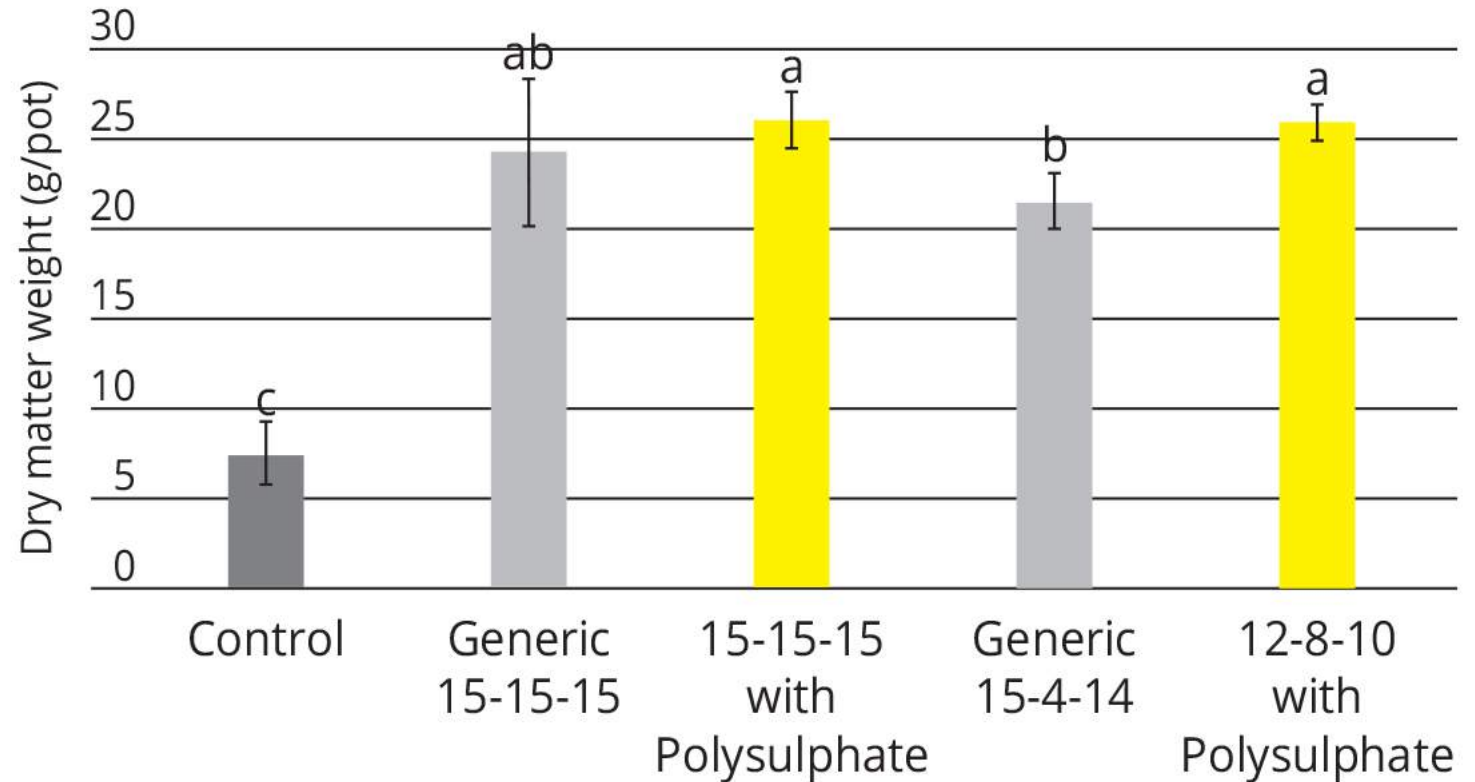
The background of the image is a dense field of small, light-colored, spherical granules, which are polyhalite fertilizer. The granules have a slightly irregular, textured surface and are uniformly distributed across the entire frame. A bright yellow rectangular box is overlaid on the left side of the image, containing the text.

Performance of polyhalite in compound fertilizers



Wheat trial CFPN, Gilat (neutral soil, pH ~7)

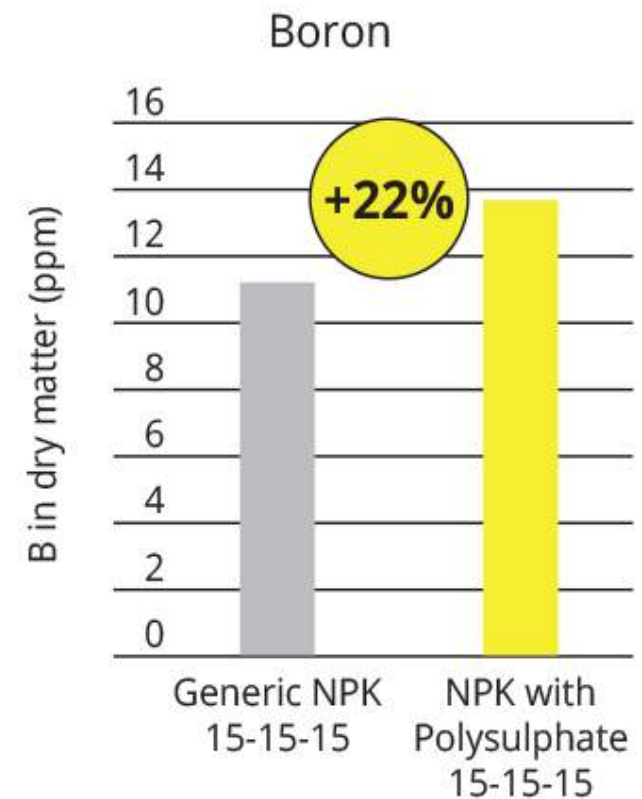
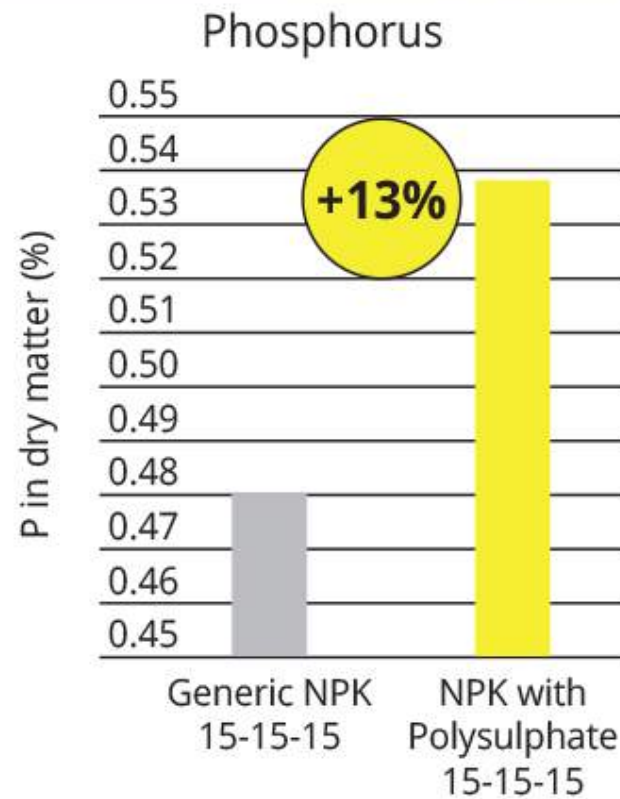
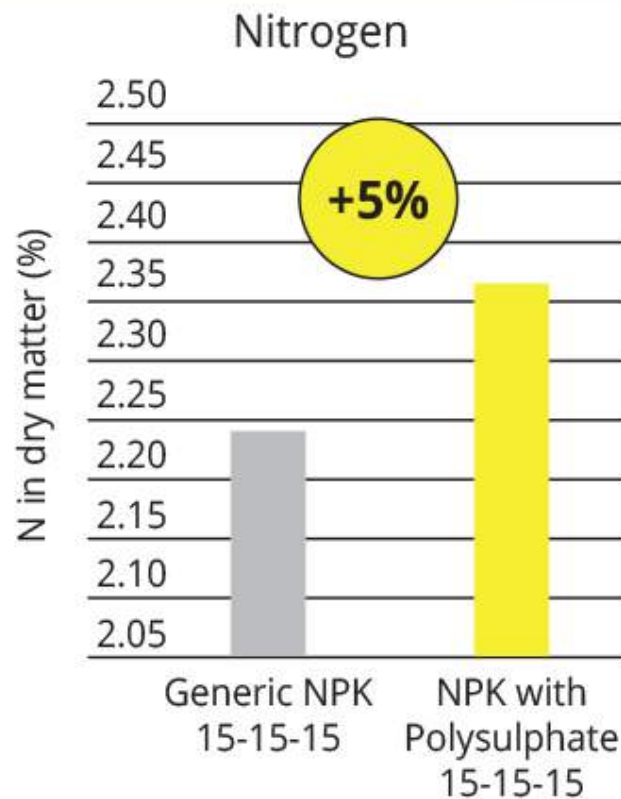
Improved
dry matter
production with
polyhalite



Different letters within columns indicate statistically significant differences (error bars for SD)

Addressing nutrients use efficiency

Better nutrients use efficiency with Higher N & P uptake by plant and less loses to the environment



Published at IPI literature



Fertilizer and Chemicals Corporation (PVFCCo), Vietnam

2016

Improves Coffee and Quality in

by PVFCCo.

(1)Petrovietnam Fertilizer and Chemicals Corporation (PVFCCo), Vietnam

2016

Polyhalite

t Yield and Quality

e-ifc No. 52, March 2018



Polyhalite Compared to KCl and Gypsum in Alfalfa Fertilization

Bernardi, A.C.C.^{(1)*}, G.B. de Souza⁽¹⁾, and F. Vale⁽²⁾

Abstract


Poor acidic soils significantly challenge potassium (K) availability for crop production in Brazil. Therefore, huge amounts of K fertilizers, mostly KCl, are applied yearly. Nevertheless, KCl agronomic efficiency in

(1)Embrapa Pecuária Sudeste, São Carlos, SP, Brazil
(2)IPI Coordinator for Latin America, International Potash Institute (IPI), Zug, Switzerland

28% 15:29 Cellcom

e-ifc Archive

e-ifc No. 51, December 2017



Polyhalite - A Multi-Nutrient Fertilizer Preventing Ca and Mg Deficiencies in Greenhouse Tomatoes under Desalinated Irrigation Water

Sacks, M.^{(1)*}, S. Gantz⁽¹⁾, U. Mezuman⁽²⁾, L. Peled⁽²⁾, and P. Imas⁽³⁾

Abstract


Greenhouse tomatoes (*Lycopersicon esculentum* Mill.) represent a highly

(1)Agricultural Extension Services,

28% 15:30 Cellcom

e-ifc Archive

e-ifc No. 48, March 2017



Introducing Polyhalite to Brazil: First Steps of a New Fertilizer

Vale, F.^{(1)*}, and D.R. Sérgio⁽²⁾

Abstract


Being among the world's leading agricultural producers, Brazil imports and uses huge amounts of fertilizer, yearly. High soil acidity, adverse side-effects of liming and poor soil fertility challenge the efficacy of conventional

(1)IPI Coordinator Latin America, International Potash Institute (IPI), Zug, Switzerland
(2)ICL Agronomy Supervisor, Piracicaba, SP, Brazil
* Corresponding

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e-ifc Archive

e-ifc No. 44, March 2016



Polyhalite Application Improves (Coffea robusta) Yield and Quality in Vietnam

Article from report contributed by IPI Vietnam⁽¹⁾

e-ifc Archive

e-ifc No. 47, December 2016



Agronomic Efficiency of Polyhalite Application on Peanut Yield and Quality in Vietnam

Hoang Minh Tam^{(1)*}, Duong Minh Thi Thuan⁽¹⁾, Ho Huy Cuong⁽¹⁾, and F. Vale⁽²⁾

Abstract

Peanut (*Arachis hypogaea* L.) has an important role in traditional crop rotation in Vietnam, and particularly in Binh Dinh province, where the planting area ranges from 8,300-10,200

28% 15:30 Cellcom

e-ifc Archive

e-ifc No. 47, December 2016



Polyhalite Application Improves (Coffea robusta) Yield and Quality in Vietnam

Article from report contributed by IPI Vietnam⁽¹⁾

Summing up

1

A natural, multi nutrient fertilizer, with low CI and containing boron

Increasing yield, quality and farmers' income

2

With a special release pattern that enables 'Extended Availability'

Less nutrients losses, better residual effect

3

That can be applied in a wide range of application rates, to all crops and in all soils types

Versatile in many agro-climatic regions; from roses to wheat...





Thank you

www.polysulphate.com