Compendium of

Fertilizerplus

Field trials

ICL Fertilizers

Content

By Crops

By Country

Polysulphate

Trial

Banana
Brazil

When
Fertilizer application: November 2016
Harvest: August 2017

Where
Juquia, Sao Paulo state, Brazil

Crop
Banana *(Musa acuminata)*, Cavendish Subgroup

Soil type
Ultisol, high clay content
(430 g kg^{-1} of clay)

Measurements
- Yield
- Vigor of bunches
- Diameter of stems

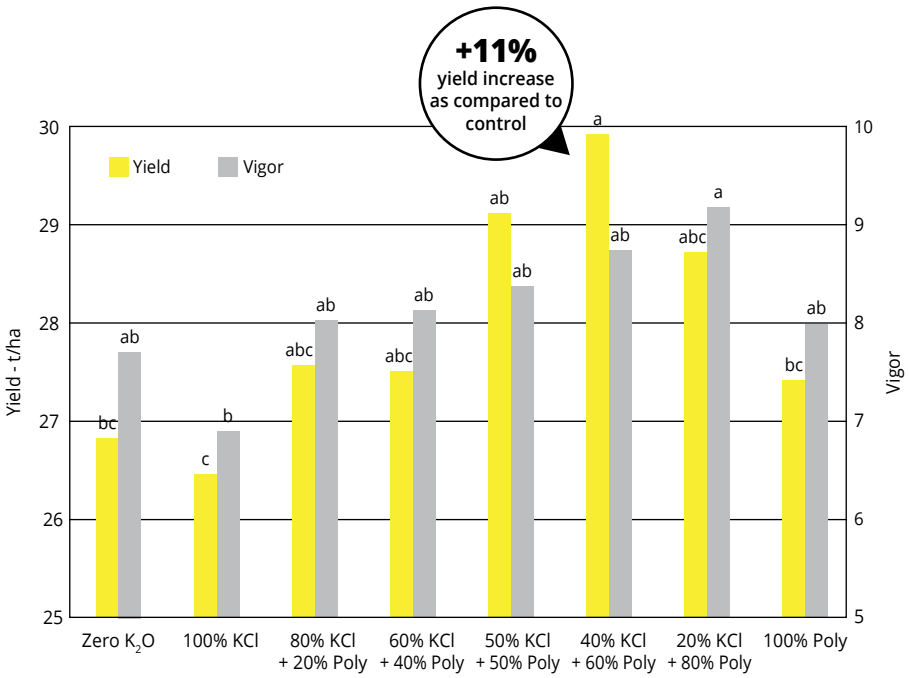
Objective
To evaluate the effect substituting KCl fertilizer with Polysulphate as a source of K has on the yield and quality of banana.

Treatments
This randomized block trial consisted of four replicates with eight treatments. Different blends of KCl and Polysulphate were tested to supply 360 kg K_2O ha^{-1}:

1) Control, without K application
2) 100% KCl
3) 80% KCl + 20% Polysulphate
4) 60% KCl + 40% Polysulphate
5) 50% KCl + 50% Polysulphate
6) 40% KCl + 60% Polysulphate
7) 20% KCl + 80% Polysulphate
8) 100% Polysulphate

The fertilizers were applied onto the soil surface at two times: first in November 2016; second in January 2017. 100 kg P_2O_5 ha^{-1} as MAP and 250 kg N ha^{-1} as ammonium nitrate were applied at the same time in all treatments.

Results
- Polysulphate increased the vigor of bunches and slightly increased the diameter of stems.
- Partial replacement of KCl by Polysulphate increased crop productivity.
- The KCl: Polysulphate blends with 50% to 60% Polysulphate led to the greatest increases, even in high fertility soils.



Different letters above bars indicate significant differences among treatments (P<0.05)

From research funded by the International Potash Institute www.ipipotash.org.

Polysulphate

Trial

Black pepper
Vietnam

When
January 2016
December 2017
Garden planted in 2012

Where
Gia Lai province, Central Highlands, Vietnam

Crop
Black pepper *(Piper nigrum L.)*

Soil type
Acidic reddish brown soil

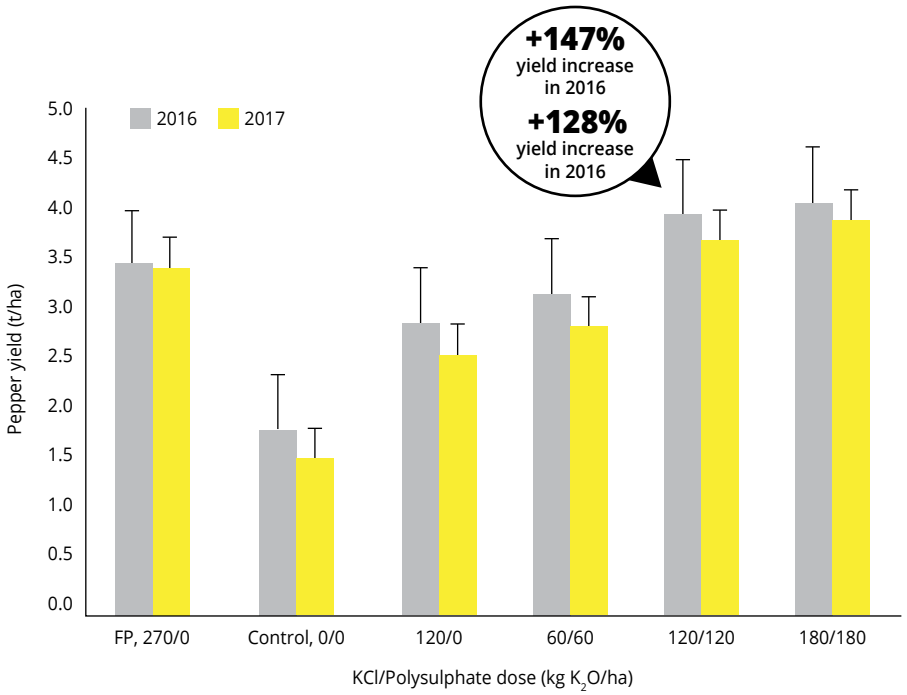
Measurements
- Yield and quality
- Vegetative growth
- Diagnostic leaves
- Mealybugs infestation

From research funded by the International Potash Institute www.ipipotash.org.

Objective
To evaluate the effectiveness of Polysulphate as a supplementary fertilizer on black pepper performance, yield, quality, and economic efficiency under the conditions of the Central Highlands of Vietnam.

Treatments
The experiment was set according to a randomized complete block design (RCBD) with four replications. Polysulphate was examined in combination with MOP (KCl), in equal proportions, to provide doses of 120, 240 and 360 kg K_2O/ha/yr, split into six applications during the year. These treatments were compared to doses of zero (control), 120, and 270 (farmers' practice) kg K_2O/ha applied solely as MOP. Standard N and P fertilizers were applied in all treatments.

Results
- Fruit weight, volume and density increased with Polysulphate application combined with MOP, while fruit shedding rates reduced.
- Elongation of primary branches and number of secondary branches increased with Polysulphate application combined with MOP, while premature fruit abscission dramatically reduced.
- The combined MOP and Polysulphate applications significantly reduced mealybug infestation.
- Plants supplied with combined MOP and Polysulphate showed increased levels of leaf K, S, Ca, and Mg as compared with the unfertilized control.
- Combined MOP and Polysulphate applied at the doubled dose (240 kg K_2O/ha) gave rise to the best crop performance and to the highest yield, produce quality, and profit.



Polysulphate

Trial

Broccoli
France

When
2016

Where
France, Kervignac

Crop
Broccoli *(Brassica oleracea* var. *italica)*

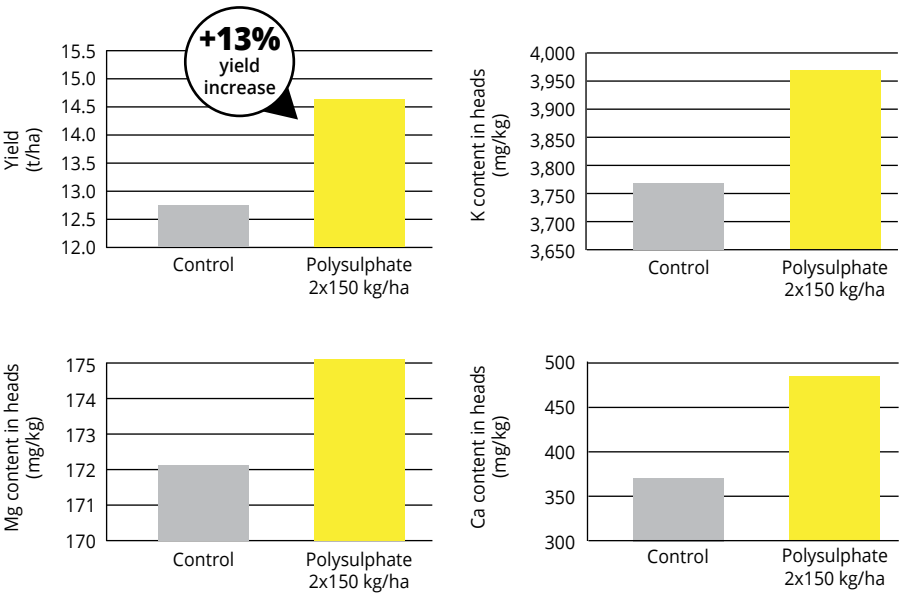
Soil type
Sandy loam soil

Measurements
- Yield
- Nutrients content in the head

Objective
To investigate the effect of the application of single and split applications of Polysulphate on the yield of broccoli.

Treatments
This field trial consisted of three treatments in four replicates:
- Farmer's fertilizer practice (control)
- Polysulphate applied 15 days after planting at a rate of 150 kg/ha.
- Polysulphate applied 15 and 40 days after planting (split application) at a rate of 150 kg/ha each (total 300 kg/ha).

Results
- The split Polysulphate application (2 x 150 kg/ha) resulted in the best response. The single application had no effect on the crop.
- The yield of the split Polysulphate treatment improved by 13% over the control, this means 1.75 mt/ha yield increase based on 25,000 plants/ha.
- The average head size increased from 534 g in the control to 604 g with the two Polysulphate applications.
- Potassium, magnesium and calcium content in the heads with the split Polysulphate application increased by 5%, 1.7% and 23% respectively compared to the control.



Polysulphate

Trial

Cabbage
Brazil

When
- Sowing: October 2016
- Harvest: January 2017

Where
Piedade, Sao Paulo state, Brazil

Crop
Cabbage *(Brassica oleracea)*

Soil type
Clay soil

Measurements
- Yield
- Incidence of black rot in the leaves *(Xanthomonas campestris)*
- Plant vigor

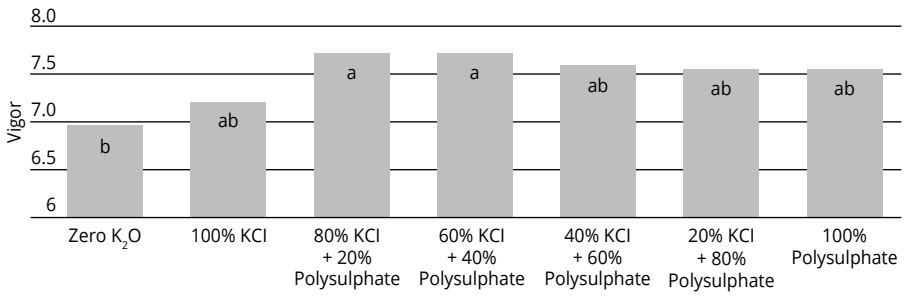
Different letters within columns indicate statistically significant differences

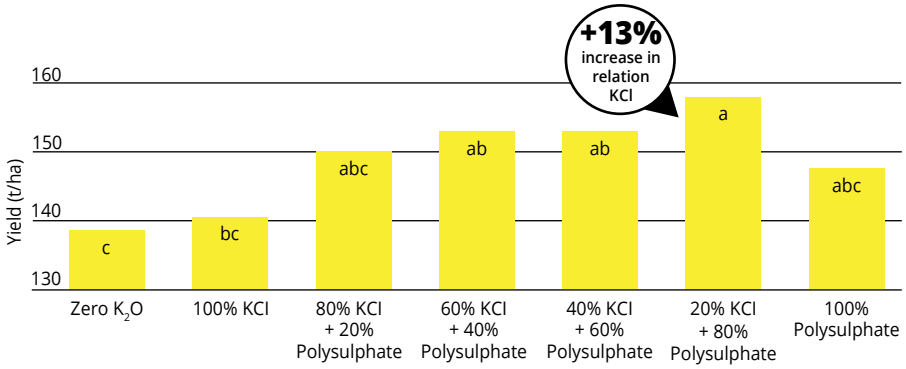
Objective
Evaluate the yield and quality of the cabbage when KCl is substituted with Polysulphate as the source of potassium.

Treatments
This randomized block trial consisted of four replicates with seven different treatments. With the exception of the control, the treatments consisted of different combination of KCl and Polysulphate with the total K_2O application rate remaining at 200 kg/ha. Each treatment was applied (broadcast) to the soil surface in 4 equal applications the day before planting and at 14, 28 and 42 days after planting.

At planting, all treatments were fertilized with 400 kg/ha of P_2O_5 (MAP), broadcast and incorporated into the soil, and 200 kg/ha of N (urea) applied at the same time as the initial treatment applications.

Results
- Polysulphate increased vigor and reduced the risk of black rot.
- Partial replacement of KCl by Polysulphate increased crop productivity.
- The ratios between 40 and 80% Polysulphate in the blend with KCl are the most indicated, even in high fertility soils.





Polysulphate

Trial

Winter cabbage
UK

When
2009

Where
Lincolnshire, UK and carried out by OAT (Oxford Agriculture Trials Ltd)

Crop
Winter cabbage
(Brassica oleracea)

Soil type
Sandy loam soil

Measurements
- Vigour
- Yield

Objective

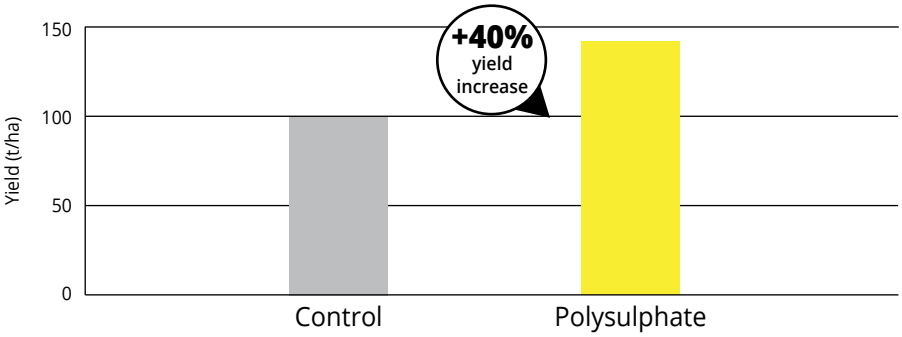
To investigate the effect of Polysulphate application on the yield of winter cabbage, with particular emphasis on response to the sulphur content.

Treatments

- The field trial consisted of five replicates.
- The whole field, including the trial site, received the standard NPK dressing used by the grower. No sulphur was applied.
- Four rates of Polysulphate were spread as a top-dressing to supply sulphur at 30, 60, 90 and 120 kg SO_3/ha (12, 24, 36 and 48 kg S/ha).
- The control plots and the three lower S-rate plots received a dressing of calcined magnesite and muriate of potash (KCl) to match the quantities of magnesium and potassium provided by the highest Polysulphate application rate. The trial site was adequately supplied with calcium.

Results

- The average vigour score for the Polysulphate plots was 90% or more throughout the winter, whereas the control plot vigour had declined to 74% by mid-autumn, subsequently remaining at that level.
- All the Polysulphate treatments showed a significant yield improvement over the control. The average yield of the Polysulphate treatments was 40% greater than the control.
- The optimum sulphur application rate was 90 kg SO_3/ha (36 kg S/ha). This rate was achieved when Polysulphate was applied at 190 kg/ha.



Polysulphate

Trial

Chinese cabbage
China

When
- Sowing: July 14, 2015
- Harvest: August 14, 2015

Where
Hainan, China

Crop
Chinese cabbage *(Brassica rapa pekinensis)*

Soil type
Paddy soil

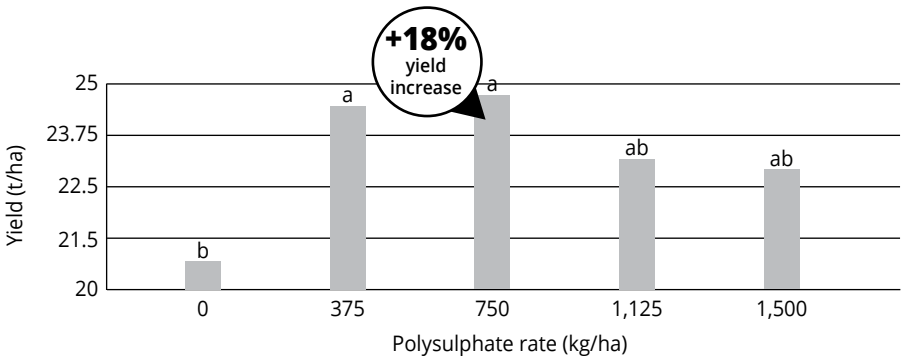
Measurements
- Yield
- Growth parameters
- Soil nutrients after harvest
- Soil pH after harvest

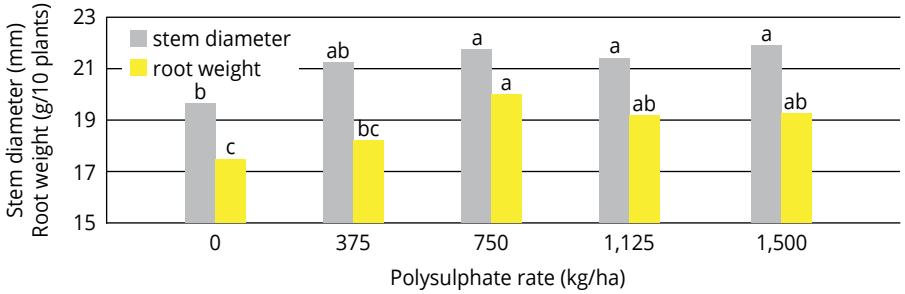
Objective
To investigate the effect of increasing rates of Polysulphate on the yield, growth parameters, concentrations of soil nutrients and soil pH after harvest of Chinese cabbage.

Treatments
This randomized block trial consisted of four replicates with five treatments. In all treatments, nitrogen, phosphorus and potassium were applied according to farmers' traditional practice: 450 kg/ha of compound fertilizer (15-15-15) + 7.5 t/ha of organic fertilizer applied as base-fertilizer. Four treatments consisted of increasing rates of Polysulphate: 375, 750, 1,125 and 1,500 kg/ha. Control treatment received the same NPK and organic fertilizer + 300 kg/ha calcium cyanamide but no Polysulphate was applied.

Results
- Potassium, Mg and Ca concentrations in soil after harvest were increased in the Polysulphate treatments when compared to the control.
- Polysulphate application increased soil pH after harvest from 4.9 (control) up to 5.28 (1,500 kg Polysulphate/ha).
- Application of Polysulphate increased significantly the stem diameter and root weight of Chinese cabbage.
- Polysulphate application increased significantly the yield. The highest yields were obtained when Polysulphate was applied at a rate of 375 and 750 kg/ha.
- Polysulphate application was highly profitable. The highest additional net profit (2,978 USD/ha) was obtained when Polysulphate was applied at a rate of 375 kg/ha.

Polysulphate (kg/ha)	Soil pH	Available K (mg/kg)	Exchangeable Mg (mg/kg)	Exchangeable Ca (mg/kg)
0	4.88	124.4	90.2	772.6
375	4.99	145.0	126.9	1,142.6
750	5.06	218.2	132.4	1,886.6
1,125	5.03	199.0	180.3	1,063.1
1,500	5.28	286.4	208.5	2,138.3





Different letters above bars indicate significant differences among treatments ($p<0.05$)

Polysulphate

Trial

Cabbage
Turkey

When
Sowing:
September 2016
Harvest:
January 2017

Where
Antalya, Turkey

Crop
Cabbage *(Brassica oleracea)*

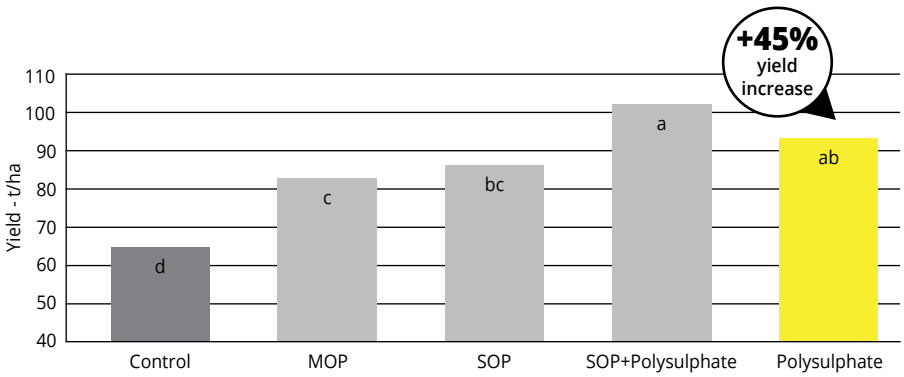
Soil type
Sandy loam soil

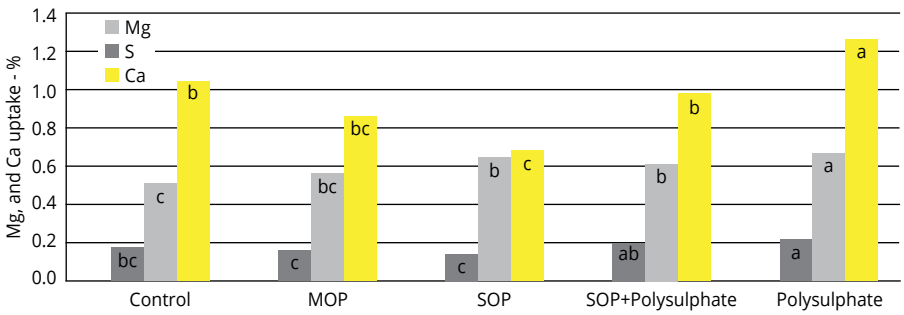
Measurements
- Yield
- Quality parameters
- Nutrients uptake

Objective
To investigate the effect of Polysulphate, potassium sulphate (SOP) and potassium chloride (MOP, KCl) on the yield, quality parameters and nutrient uptake of cabbage.

Treatments
This randomized trial consisted of four replicates with five treatments. Nitrogen, phosphorus and potassium were applied according to target yield and soil tests at a rate of 250 kg N ha^{-1} (as urea and di ammonium phosphate, DAP), 100 kg P_2O_5 ha^{-1} (as di ammonium phosphate, DAP) and 300 kg K_2O ha^{-1} (as Polysulphate, SOP or MOP). An additional treatment consisted in K given 50% from SOP and 50% from Polysulphate. Control treatment received the same N and P doses but no K was applied.

Results
- Uptake of Ca, Mg and S were highest in the Polysulphate treatment. Also Ca, Mg and S concentrations in the leaves were highest in the Polysulphate treatment.
- Polysulphate + SOP treatment resulted in the highest total and marketable yield, followed by the Polysulphate treatment. Also head weight, width and height followed the same behavior.
- Polysulphate application increased the net return and was very profitable, with a B:C (benefit:cost ratio) of 20.3 for Polysulphate treatment and 28.3 for the Polysulphate+SOP treatment.
- The highest antioxidant activity, phenols concentration and total soluble solids (TSS) were found in the Polysulphate + SOP treatment, followed by the Polysulphate treatment which statistically did not differ from the Polysulphate + SOP treatment. Vitamin C concentration was found highest at the Polysulphate treatment.





Different letters above bars indicate significant differences among treatments ($p<0.001$).

From research funded by the International Potash Institute www.ipipotash.org.

Polysulphate

Trial

Cabbage
India

When
Sowing:
October 2013
Harvest: March 2014

Where
Hessaraghatta,
Karnataka, India

Crop
Cabbage *(Brassica oleracea* var. *capitata)*
cv. Tetries

Soil type
Sandy clay loam
(Typic haplustepts)

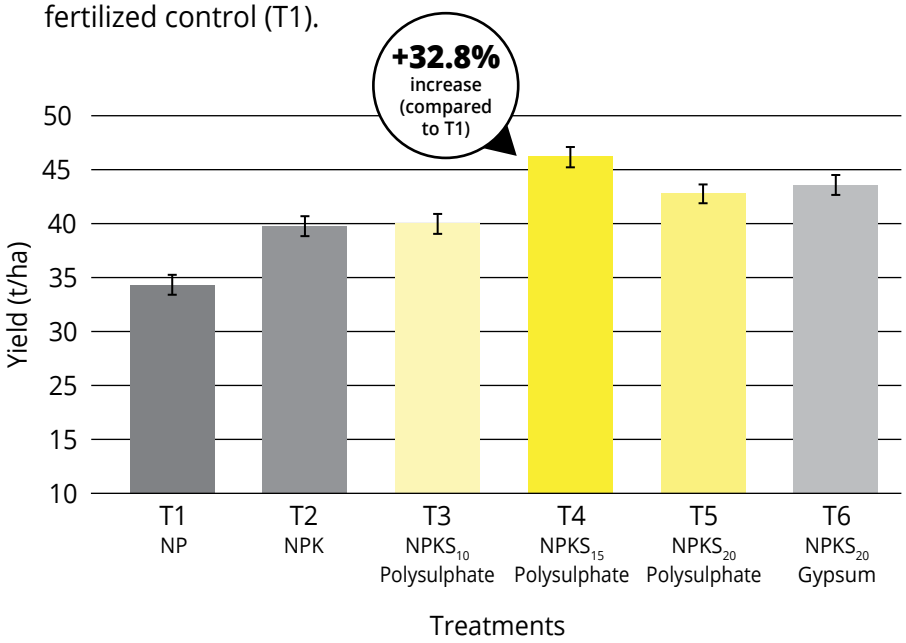
Measurements
- Yield
- Quality
- Growth parameters
- Nutrient uptake

Objective
To test the efficacy of Polysulphate as a sulphur source on the performance of cabbage crop in India.

Treatments
The experiment was laid out in a randomized block design with three replicates and included six treatments:
- T1: Control without S and K fertilization (100% NP only through urea, DAP)
- T2: 100% NPK (urea, DAP, Muriate of Potash (MOP))
- T3: 100% NP + 50% S through Polysulphate (10 kg S ha^{-1}) (balanced K through MOP to make 100% K)
- T4: 100% NP + 75% S through Polysulphate (15 kg S ha^{-1}) (balanced K through MOP to make 100% K)
- T5: 100% NP + 100% S through Polysulphate (20 kg S ha^{-1}) (balanced K through MOP to make 100% K)
- T6: 100% NPK (urea, DAP, MOP) + 100% S through gypsum (20 kg S ha^{-1})

The recommended dose of fertilizers: 150 kg N, 100 kg P_2O_5, 125 kg K_2O ha^{-1} and 20 kg S ha^{-1} was applied as per the treatments. Farm yard manure (FYM) was also applied at 25 t ha^{-1} in the last plough.

Results
- S application significantly contributed to increased yield and quality (head diameter and compactness at harvest) of cabbage.
- S application in the form of Polysulphate, up to 75% of the recommended S dose (T4), enhanced plant growth and development, improving plant height and number of leaves.
- Highest ascorbic acid content and TSS were obtained with S application as Polysulphate, 75% of the recommended S dose (T4).
- N, K, Ca, and S uptake by cabbage crop was highest when S was applied in the form of Polysulphate, up to 75% of the recommended S dose (T4).
- The highest yield was obtained with a full dose N-P-K and 75% S dose delivered through Polysulphate (T4), which gave rise to 32.8% increase in the yield of cabbage, compared to the non-fertilized control (T1).



Bars indicate LSD at P<0.05.

From research funded by the International Potash Institute www.ipipotash.org.

Polysulphate

Trial

Carrot
France

When
Sowing: April 2019
Harvest: July 2019

Where
Saint-Jean-Brévelay, Brittany, France

Crop
Carrot *(Daucus carota* cv. *Salto)*

Soil type
Loamy soil, pH 6

Measurements
Yield

Objective

To compare three different sources of potassium (MOP, SOP and standard Polysulphate) on the yield of carrots grown in the north–west of France.

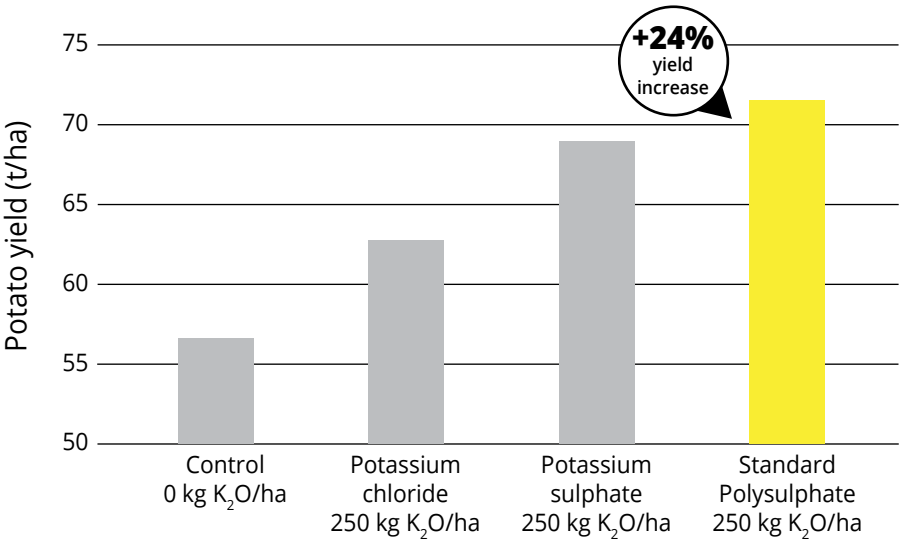
Treatments

The trial consisted of micro plots with 4 replicates. The treatments had the same potassium dose (250 kg K_2O/ha) given as either MOP, SOP or standard Polysulphate.

Nitrogen was applied as per farmers' practice at a rate of 84 kg N/ha (as 250 kg of ammonium nitrate). No phosphorus was applied because soil analysis showed a high soil P content.

Results

Polysulphate application increased carrot yield by in all cases: by 24% compared with the control (no K application); by 12.5% compared to MOP; and by 3% compared to SOP.



From research funded by the International Potash Institute www.ipipotash.org.

Polysulphate

Trial

Cauliflower
India

When
Sowing:
October 2013
Harvest: March 2014

Where
Hessaraghatta,
Karnataka, India

Crop
Cauliflower *(Brassica oleracea* var. *botrytis)* cv. Unathi

Soil type
Sandy clay loam
(Typic haplustepts)

Measurements
- Yield
- Quality
- Growth parameters
- Nutrient uptake

Bars indicate LSD at P<0.05.

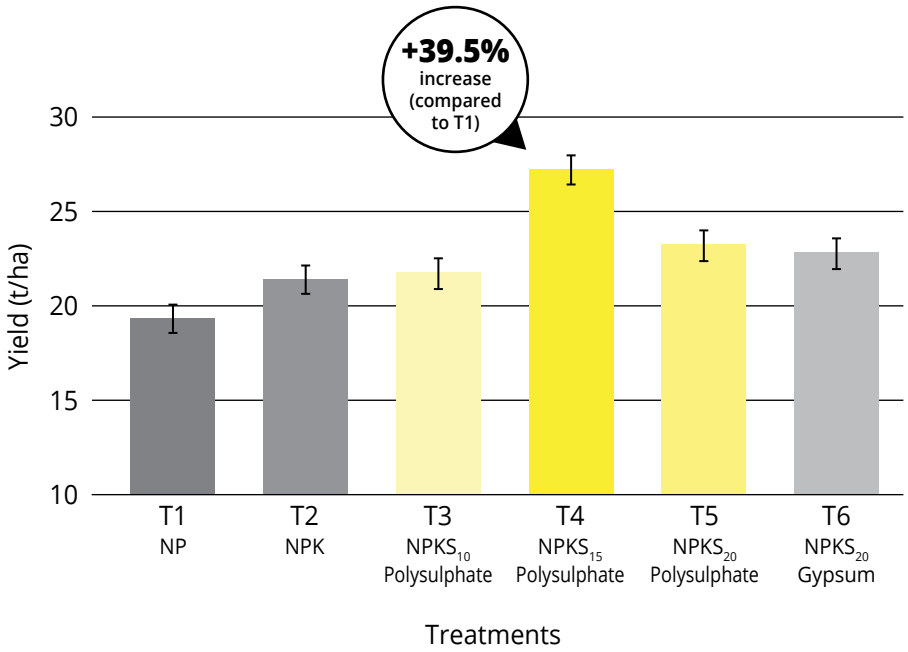
From research funded by the International Potash Institute www.ipipotash.org.

Objective
To test the efficacy of Polysulphate as a sulphur source on the performance of cauliflower crop in India.

Treatments
The experiment was laid out in a randomized block design with three replicates and included six treatments:
- T1: Control without S and K fertilization (100% NP through urea and DAP only)
- T2: 100% NPK (urea, DAP, Muriate of Potash (MOP))
- T3: 100% NP + 50% S through Polysulphate (10 kg S ha^{-1}) (balanced K through MOP to make 100% K)
- T4: 100% NP + 75% S through Polysulphate (15 kg S ha^{-1}) (balanced K through MOP to make 100% K)
- T5: 100% NP + 100% S through Polysulphate (20 kg S ha^{-1}) (balanced K through MOP to make 100% K)
- T6: 100% NPK (urea, DAP, MOP) + 100% S through gypsum (20 kg S ha^{-1})

The recommended dose of fertilizers: 150 kg N, 100 kg P_2O_5, 125 kg K_2O ha^{-1} and 20 kg S ha^{-1} was applied as per the treatments. Farm yard manure (FYM) was also applied at 25 t ha^{-1} in the last plough.

Results
- S application significantly contributed to increased yield and quality (curd diameter and compactness at harvest) of cauliflower.
- S application in the form of Polysulphate, up to 75% of the recommended S dose (T4), enhanced plant growth and development, improving plant height and number of leaves.
- N, K, Ca, and S uptake by cauliflower crop was highest when S was applied in the form of Polysulphate, up to 75% of the recommended S dose (T4).
- The highest yield was obtained with a full dose N-P-K and 75% S dose delivered through Polysulphate (T4), which gave rise to 39.5% increase in the yield of cauliflower, compared to the non-fertilized control (T1).



Polysulphate
Trial

Coffee
Vietnam

When
First application:
April 2015
Harvested:
December 2015

Where
Di Linh district, Lam Dong Province, Vietnam

Crop
Coffee *(Coffea robusta)*

Soil type
Grey soil

Measurements
- Yield
- Fruit weight
- A-size core

Objective
To evaluate the efficacy of Polysulphate to increase coffee yield in Vietnam, and to evaluate the cost-effectiveness of applying fertilizers in split doses compared to the traditional practice of a single application of urea, KCl, and fused Ca, Mg, and P.

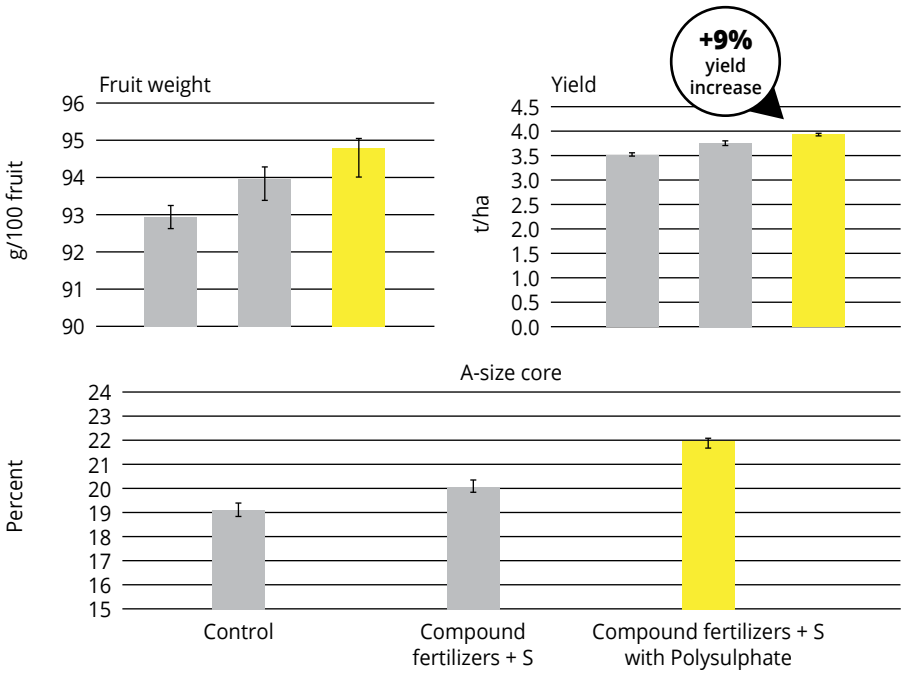
Treatments
This completely randomized block trial comprised three replications, each with three treatments:
1) Traditional practice/control: single application of urea, KCl, and fused Ca, Mg, and P.
2) Commercially available compound fertilizers (with S but no Ca or Mg).
3) Same as (2) but supplemented with Polysulphate.

In the two treatments, the total fertilizer dose was split into four applications, one at the beginning of the dry season and the remaining three in early, mid, and late rainy season.

Treatment	Urea	Fused Ca Mg P	KCl	NPKS 16-16-8-13	NPK 15-15-15	NPKS 15-18-20-10	Polysulphate
Control	715	1193	545	-	-	-	-
Compound fertilizers + S	250	-	200	400	500	500	-
Compound fertilizers + S with Polysulphate	250	-	153	400	500	500	200

Application rate: kg/ha

Results
- Supplementing NPK with Polysulphate resulted in an increase in yield of 9% and superior quality produce – more than 22% of the cores were of size A, or larger than 6.3 mm in diameter.
- Higher yield was due to faster growth, longer fruiting branches, less shedding of immature fruit, and larger and heavier cores.
- Polysulphate application also increased net profits by 10%.



Bars indicate LSD at 5%.

Source: Petrovietnam Fertilizer and Chemicals Corporation

Polysulphate

Trial

Coffee
Vietnam

When
First application:
April 2015
Harvested:
December 2015

Where
Bao Lam district,
Lam Dong Province,
Vietnam

Crop
Coffee *(Coffea robusta)*

Soil type
Reddish brown soil

Measurements
- Yield
- Fruit weight
- A-size core

Bars indicate LSD at 5%.

Source: Petrovietnam Fertilizer and Chemicals Corporation

Objective
To evaluate the efficacy of Polysulphate to increase coffee yield in Vietnam, and to evaluate the cost-effectiveness of applying fertilizers in split doses compared to the traditional practice of a single application of urea, KCl, and fused Ca, Mg, and P.

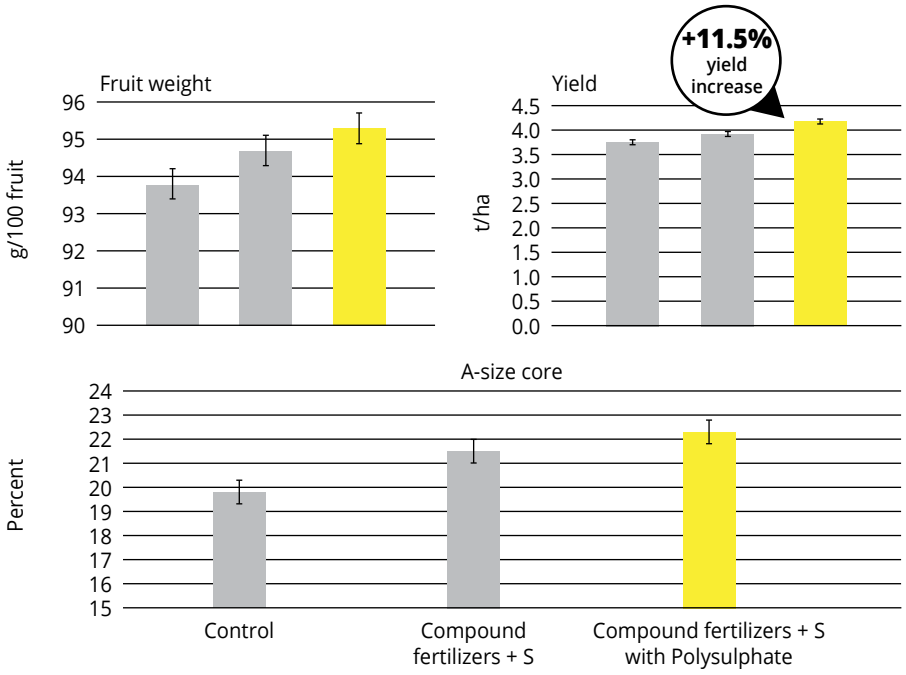
Treatments
This completely randomized block trial comprised three replications, each with three treatments:
1) Traditional practice/control: single application of urea, KCl, and fused Ca, Mg, and P.
2) Commercially available compound fertilizers (with S but no Ca or Mg).
3) Same as (2) but supplemented with Polysulphate.

In the two treatments, the total fertilizer dose was split into four applications, one at the beginning of the dry season and the remaining three in early, mid, and late rainy season.

Treatment	Urea	Fused Ca Mg P	KCl	NPKS 16-16-8-13	NPK 15-15-15	NPKS 15-18-20-10	Polysulphate
Control	715	1193	545	-	-	-	-
Compound fertilizers + S	250	-	200	400	500	500	-
Compound fertilizers + S with Polysulphate	250	-	153	400	500	500	200

Application rate: kg/ha

Results
- Supplementing NPK with Polysulphate resulted in an increase in yield of 11.5% and superior quality produce – more than 22% of the cores were of size A, or larger than 6.3 mm in diameter.
- Higher yield was due to faster growth, longer fruiting branches, less shedding of immature fruit, and larger and heavier cores.
- Polysulphate application also increased net profits by 14%.



Polysulphate

Trial

Cotton
Turkey

When
Sowing: May 2016
Harvest:
October 2016

Where
Antalya, Turkey

Crop
Cotton *(Gossypium hirsutum)*

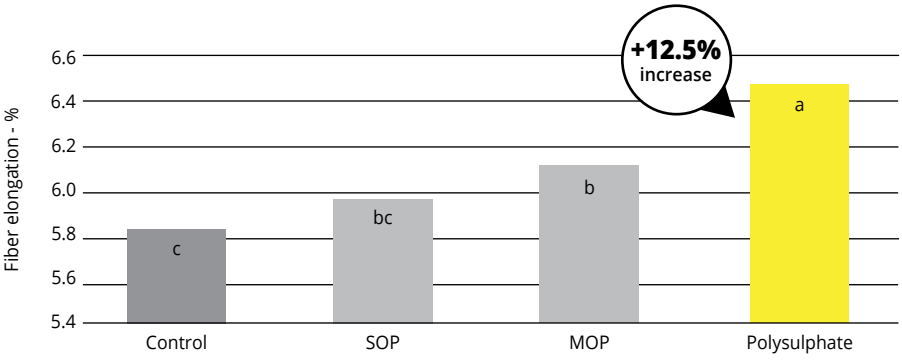
Soil type
Sandy loam soil

Measurements
- Yield
- Fiber elongation

Objective
To investigate the effect of Polysulphate, potassium sulphate (SOP) and potassium chloride (MOP, KCl) on the yield and quality parameters of cotton.

Treatments
This randomized trial consisted of four replicates with four treatments. Nitrogen, phosphorus and potassium were applied according to target yield and soil tests at a rate of 250 kg N ha^{-1} (as ammonium nitrate and di ammonium phosphate, DAP), 184 kg P_2O_5 ha^{-1} (as di ammonium phosphate, DAP) and 210 kg K_2O ha^{-1} (as Polysulphate, SOP or MOP). Control treatment received the same N and P doses but no K was applied.

Results
- Seed cotton yield was significantly increased by all 3 K sources. The yield of the Polysulphate treatments was 77% greater than the control without K application. Yields of Polysulphate and SOP treatments were significantly the same.
- Polysulphate application increased the net return and was very profitable, with a B:C (benefit:cost ratio) of 9.2.
- The highest fiber elongation was found in the Polysulphate treated cottons. This is one of the most important physical parameters for cotton quality.



Different letters above bars indicate significant differences among treatments ($p<0.001$).

From research funded by the International Potash Institute www.ipipotash.org.

Polysulphate

Trial

Mixed pasture
The Netherlands

When
Sowing: 2016
Harvested: 2019
(1st and 2nd cuts)

Where
Heerenveen, the Netherlands

Crop
Mixed pasture (red and white clover and ryegrass) *(Trifolium repens, Trifolium pratense and Lolium perenne)*

Soil type
Sandy

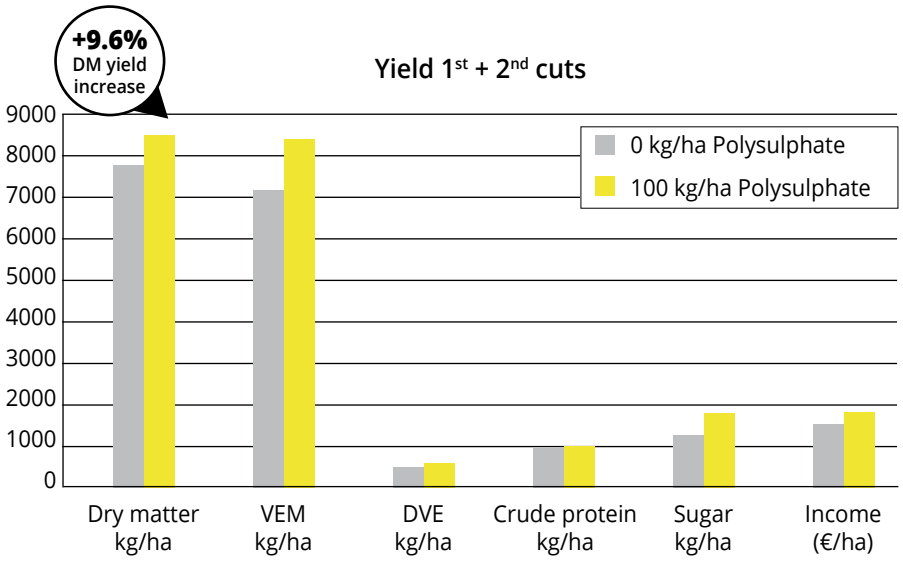
Measurements
- Dry matter yield
- Feed unit milk (VEM)
- Intestine digestible protein (DVE)
- Crude protein
- Sugar content

Objective
To evaluate the effect of Polysulphate on the yield and quality of a mixed pasture (grass and clover) in an organic field in the Netherlands.

Treatments
The trial consisted of two strips of grass pasture. Each 20 x 100 meter strip received 25 t/ha of cattle slurry in the 1st cut, and 10 t/ha in the 2nd cut. One strip was also treated with 100 kg/ha of granular Polysulphate in the 1st cut.

The grass and clover from 4 different rectangles in each strip were weighed and analyzed. These 3 x 2 meter rectangles were 20 meters apart.

Results
- Polysulphate application increased the dry matter production by 9.6%.
- Nutritional values of the forage including feed unit milk, intestine digestible protein and sugar content also improved with Polysulphate application.
- Additional income due to Polysulphate application was € 273/ha (based on a price of € 0.17/kg VEM and €0.65/kg DVE).



Polysulphate

Trial

Mixed pasture
The Netherlands

When
Sowing: 2018
Harvested: 2019
(1st and 2nd cuts)

Where
Gorredijk, the Netherlands

Crop
Mixed pasture (red and white clover and ryegrass) *(Trifolium repens, Trifolium pratense and Lolium perenne)*

Soil type
Sandy

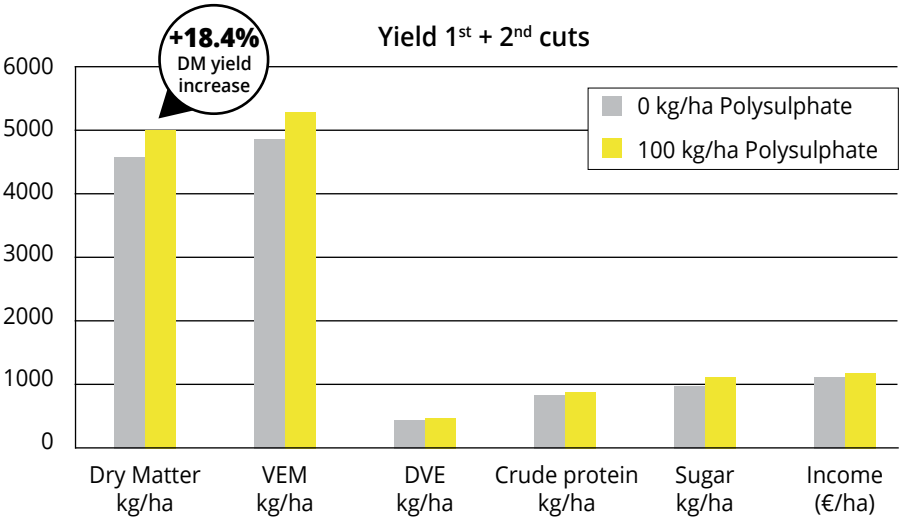
Measurements
- Dry matter yield
- Feed unit milk (VEM)
- Intestine digestible protein (DVE)
- Crude protein
- Sugar content

Objective
To evaluate the effect of Polysulphate on the yield and quality of a mixed pasture (grass and clover) grown on sandy soil in the Netherlands.

Treatments
The trial consisted of two strips of grass pasture. Each 20 x 100 meter strip received 22 t/ha of cattle slurry each cut, 24 kg N/ha and 15 KG SO_3/ha in the first cut and 27 kg N/ha and in 2nd cut. One strip was also treated with 100 kg/ha of granular Polysulphate in the 1st cut.

The grass and clover from 4 different rectangles in each strip were weighed and analyzed. These 3 x 2 meter rectangles were 20 meters apart.

Results
- Polysulphate application increased the dry matter production by 18.4%.
- Nutritional values of the forage including feed unit milk, intestine digestible protein, crude protein and sugar content also improved with Polysulphate application.
- Additional income due to Polysulphate application was € 68/ha (based on a price of € 0.17/kg VEM and €0.65/kg DVE).



Polysulphate

Trial

Mixed grass
The Netherlands

When
Sowing: 2018
Harvested: 2019
(1st and 2nd cuts)

Where
Hantumhuizen, the Netherlands

Crop
Mixed grass (perennial and cross-bred ryegrass, tall fescue and Festulolium)
(Lolium perenne, Festuca arundinacea and Festulolium sp.)

Soil type
Clay

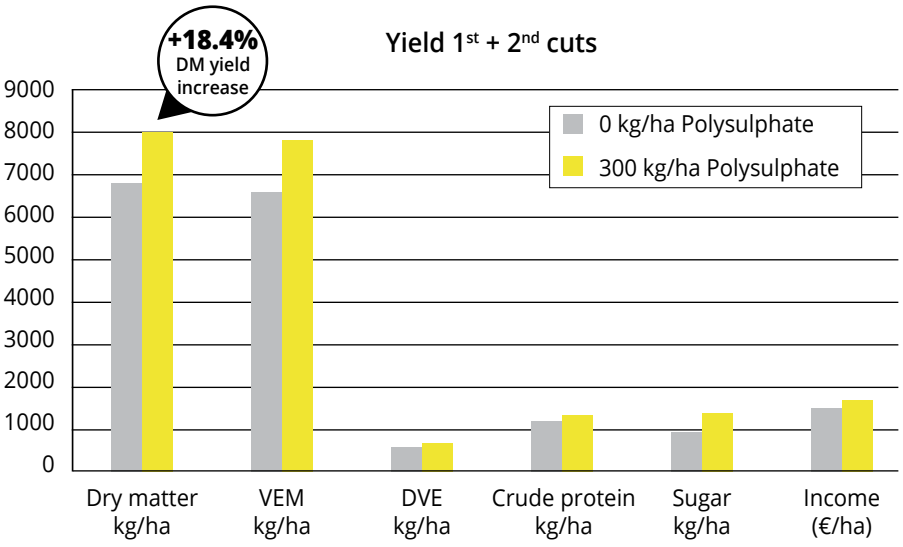
Measurements
- Dry matter yield
- Feed unit milk (VEM)
- Intestine digestible protein (DVE)
- Crude protein
- Sugar content

Objective
To evaluate the effect of Polysulphate on the yield and quality of a grass pasture grown on clay soil in the Netherlands.

Treatments
The trial consisted of two strips of grass pasture. Each 20 x 100 meter strip received 35 t/ha of cattle slurry in the 1st cut, and 81 kg N/ha in the 1st and 2nd cut. One strip was also treated with 300 kg/ha of granular Polysulphate in the 1st cut.

The grass from 4 different rectangles in each strip was weighed and analyzed. These 3 x 2 meter rectangles were 20 meters apart.

Results
- Polysulphate application increased the dry matter production by 18.4%.
- Nutritional values of the forage including feed unit milk, intestine digestible protein, crude protein and sugar content also improved with Polysulphate application.
- Polysulphate application increased income by € 195/ha (based on a price of € 0.17/kg VEM and €0.65/kg DVE).



Polysulphate

Trial

Mixed pasture
The Netherlands

When
Sowing: 2018
Harvested: 2019
(1st and 2nd cuts)

Where
Gersloot, the Netherlands

Crop
Mixed pasture (red and white clover and ryegrass) *(Trifolium repens, Trifolium pratense and Lolium perenne)*

Soil type
Peat

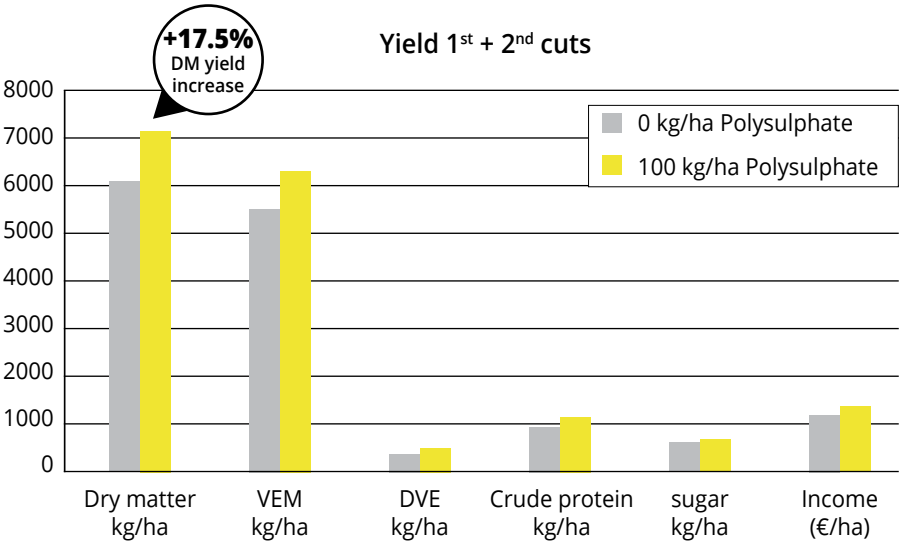
Measurements
- Dry matter yield
- Feed unit milk (VEM)
- Intestine digestible protein (DVE)
- Crude protein
- Sugar content

Objective
To evaluate the effect of Polysulphate on the yield and quality of a mixed pasture (grass and clover) grown on a peat soil in the Netherlands.

Treatments
The trial consisted of two strips of grass pasture. Each 20 x 100 meter strip received 46 kg N/ha in the 1st and 2nd cut. One strip was also treated with 100 kg/ha of granular Polysulphate in the 1st cut.

The grass and clover from 4 different rectangles in each strip were weighed and analyzed. These 3 x 2 meter rectangles were 20 meters apart.

Results
- Polysulphate application increased the dry matter production by 17.5%.
- Nutritional values of the forage including feed unit milk, intestine digestible protein, crude protein and sugar content also improved with Polysulphate application.
- Additional income due to Polysulphate application was € 156/ha (based on a price of € 0.17/kg VEM and €0.65/kg DVE).



Polysulphate

Trial

Green pepper
China

When
Transplant:
December 7, 2015
Harvest: January 2 - April 16, 2016

Where
Hainan, China

Crop
Green pepper
(Capsicum annuum)

Soil type
Sandy loam soil

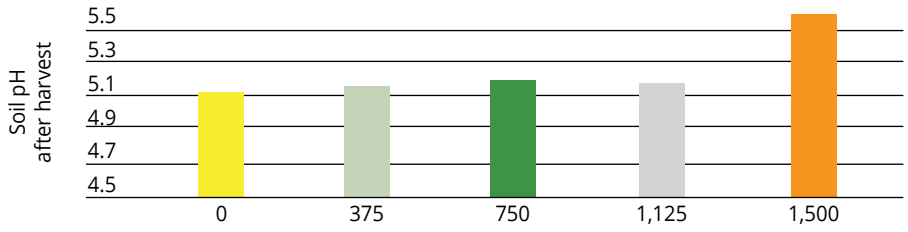
Measurements
- Yield
- Shelf life
- Soil pH after harvest

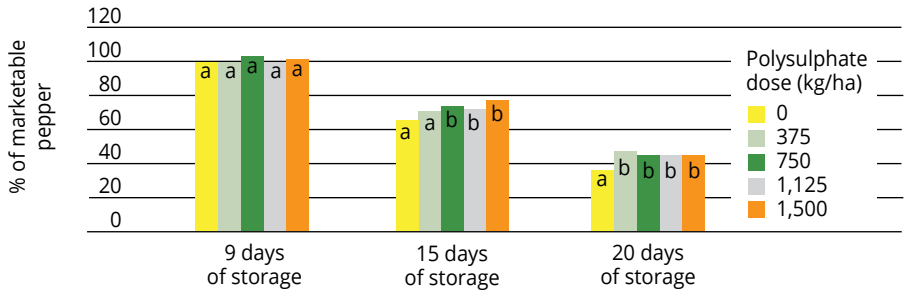
Different letters above bars indicate significant differences among treatments (p<0.05)

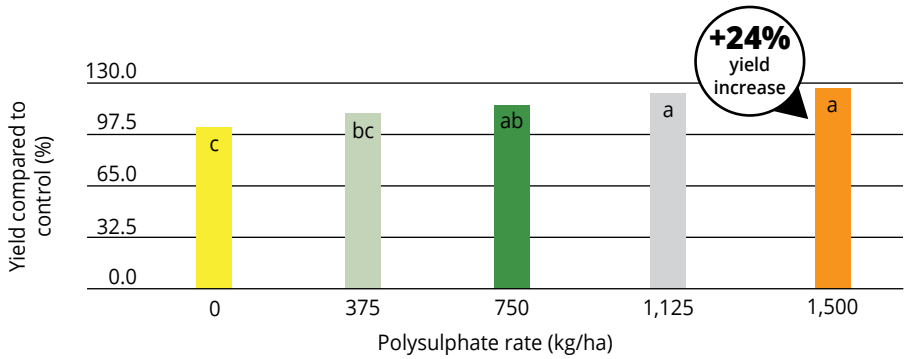
Objective
To investigate the effect of increasing rates of Polysulphate on the soil pH after harvest, yield and shelf life of green pepper.

Treatments
This randomized block trial consisted of three replicates with five treatments. In all treatments, nitrogen, phosphorus and potassium were applied according to farmers' traditional practice: 1,125 kg/ha of compound fertilizer (15-15-15) applied as base-fertilizer followed by a topdressing of 375 kg/ha of compound fertilizer at fruit stage. Four treatments consisted of increasing rates of Polysulphate: 375, 750, 1,125 and 1,500 kg/ha. Control treatment received the same NPK but no Polysulphate was applied.

Results
- Application of Polysulphate increased the pH after harvest and thus the availability of nutrients in the soil, especially for K, Ca and Mg, that in turn improves the fertility of acidic soil.
- There was no significant difference in the percentage of marketable pepper among all treatments after 9 days of storage. As the storage time was increased from 9 days to 15 and then 20 days, a significantly higher percentage of marketable pepper was achieved in treatments that contained Polysulphate, due to improved shelf life.
- Comparing Polysulphate treatments with the control, the yields of green pepper increased significantly by up to 24% at the highest dose (1,500 kg Polysulphate/ha).
- Polysulphate application was very profitable, with increasing additional profits of 960, 1,620, 2,415 and 2,250 USD/ha for 375, 750, 1,125 and 1,500 kg Polysulphate/ha respectively when compared with the control treatment.







Polysulphate

Trial

Lucerne
UK

When
2017

Where
UK

Crop
Lucerne (alfalfa, *Medicago sativa*)

Soil type
Sandy clay loam

Measurements
- N:S ratio
- Crude protein
- Digestibility

Objective

To investigate the effect of the application of Polysulphate on the nutritional quality of lucerne (alfalfa). Specifically to increase the S level and improve (tighten) the N:S ratio with the objective of increasing crude protein and improving digestibility.

Treatments

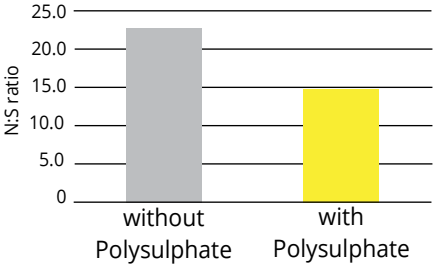
- This was a split field trial.
- A standard broadcast spring application of a phosphate/potash (PK) fertilizer was compared with a treatment providing the same PK inputs, plus sulphate, magnesium and calcium from Polysulphate.
- The rates of application of the nutrients applied are shown in the table (kg/ha):

	N	P_2O_5	K_2O	MgO	SO_3	CaO
Standard PK	0	80	120	-	-	-
PK+Polysulphate	0	80	120	12	96	34

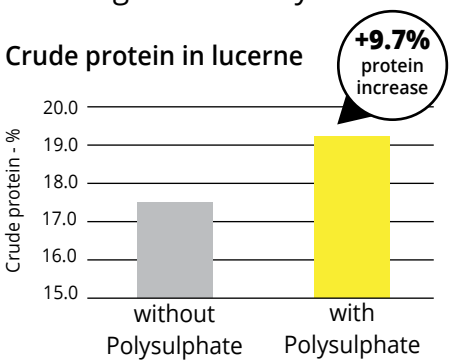
Results

- The N:S ratio of 20:1 with the standard PK fertilizer was narrowed to the desired 12:1 by the Polysulphate treatment. An N:S ratio of 20:1 is considered too wide for optimal digestibility of the fodder and for maximum nitrogen use efficiency by ruminant livestock.
- The nitrogen content of the fodder (measured as 'crude protein') was improved by the Polysulphate treatment, indicating that an adequate sulphur supply is necessary to enable this crop to fix and utilise nitrogen efficiently.

N:S ratio in lucerne



Crude protein in lucerne



Polysulphate

Trial

Maize
Argentina

When
2016

Where
Nueve de Julio, Argentina

Crop
Maize *(Zea mays)*

Soil type
Sandy loam soil

Measurements
Yield

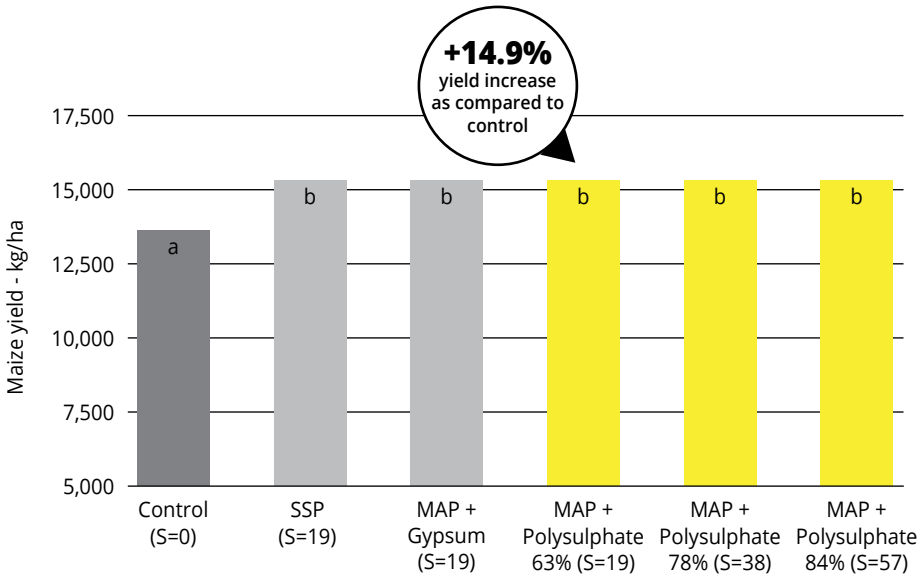
Objective
To compare, under field conditions, the agronomic and economic efficiency of fertilizer bulk blends that include Polysulphate with other current formulations.

Treatments
The treatments were allocated in a randomized complete block design with four replications.

All treatments were based on different sources of S that were applied at sowing and with a single rate of P (30 kg P_2O_5 ha^{-1}), in addition to other fertilizer combinations, including a control with no sulphur. Gypsum and single super phosphate (SSP) treatments were included, since they were the common sources of S with comparable rates of S to Polysulphate.

The crop received a broadcast fertilization with N as urea at V4-V6 stage in addition to the N applied through the MAP starter, thus providing 100 kg N ha^{-1}.

Results
- Maize responded significantly to sulphur application
- There were no statistical differences between Polysulphate and other sources of sulphur.



Different letters above bars indicate significant differences among treatments (p<0.001)

From research funded by the International Potash Institute www.ipipotash.org.

Polysulphate

Trial

Maize
Argentina

When
2017

Where
Mercedes,
Corrientes, Argentina

Crop
Maize *(Zea mays)*

Soil type
Sandy loam soil

Measurements
Yield

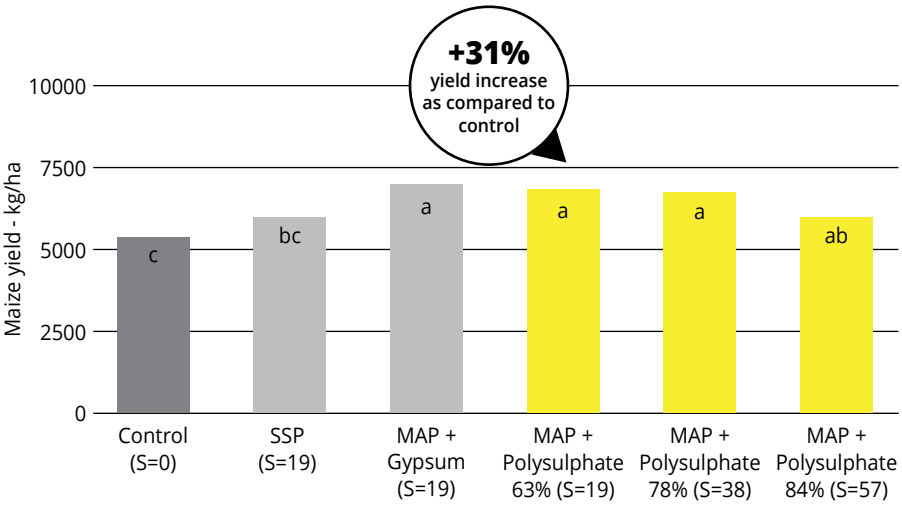
Objective
To compare, under field conditions, the agronomic and economic efficiency of fertilizer bulk blends that include Polysulphate with other current formulations.

Treatments
The treatments were allocated in a randomized complete block design with four replications.

All treatments were based on different sources of S that were applied at sowing and with a single rate of P (30 kg P_2O_5 ha^{-1}), in addition to other fertilizer combinations, including a control with no sulphur. Gypsum and single super phosphate (SSP) treatments were included, since they were the common sources of S with comparable rates of S to Polysulphate.

The crop received a broadcast fertilization with N as urea at V4-V6 stage in addition to the N applied through the MAP starter, thus providing 100 kg N ha^{-1}.

Results
There were no statistical differences between Polysulphate and gypsum. Polysulphate gave higher yield as compared with SSP.



Different letters above bars indicate significant differences among treatments (p<0.05)

From research funded by the International Potash Institute www.ipipotash.org.

Polysulphate

Trial

Silage maize
UK

When
Sowing: May 2017
Harvest:
October 2017

Where
Dorset, UK
and carried out by
Pearce Seeds

Crop
Silage maize
(Zea mays)

Measurements
Dry matter yield

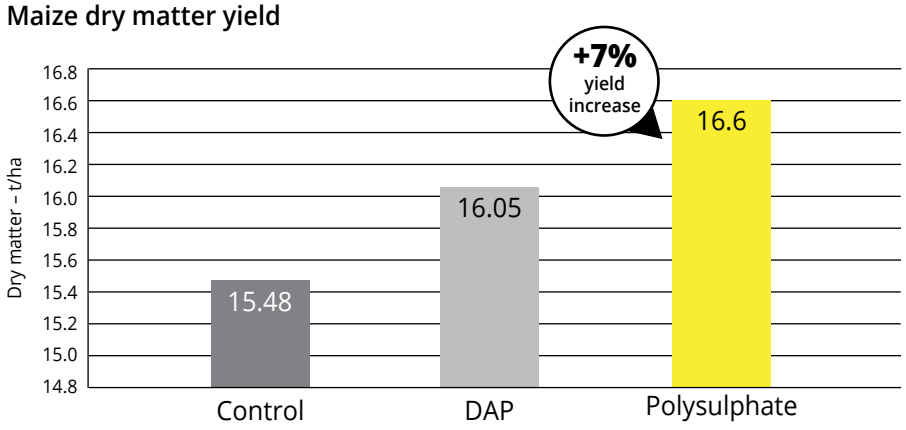
Objective
To investigate the effect of di-ammonium phosphate (DAP) or DAP with Polysulphate plus micronutrients on the early vigour and quality of maize silage.

Treatments
This randomised trial consisted of four replicates with three treatments. The DAP and the DAP/Polysulphate blend were applied at drilling to provide the same application rate of nitrogen per hectare, with the control receiving no fertiliser.

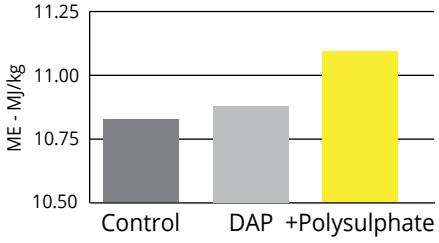
The treatment fertilisers were banded with the seed at drilling on 10 May 2017. All treatments also received additional nitrogen, with total N applications being equal.

Results
- The first assessment of crop vigour showed a positive effect from both fertiliser treatments.
- The metabolisable energy of the harvested crop was significantly higher from the Polysulphate-treated crop than the DAP treatment or the control.
- The cell wall digestibility of the Polysulphate treated crop was significantly greater than either the DAP treatment or the control.
- The Polysulphate area was worth an extra £82.50/ha or £77.40/ha after deducting the costs of Polysulphate.

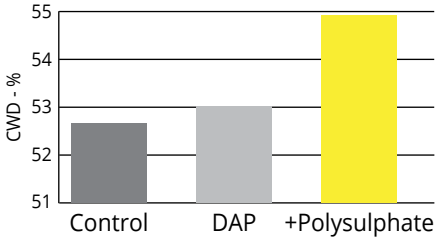
Maize dry matter yield



Silage metabolisable energy



Cell wall digestibility



Polysulphate

Trial

Maize
UK

When
2018

Where
Lincolnshire, UK

Crop
Maize *(Zea mays cv. Beethoven)*

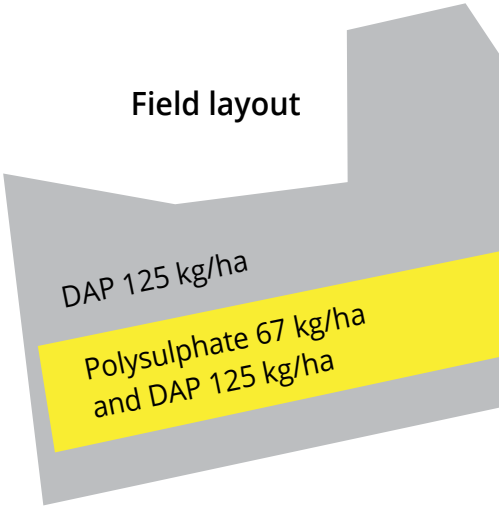
Soil type
Medium loam

Measurements
- SPAD
- Yield
- Quality

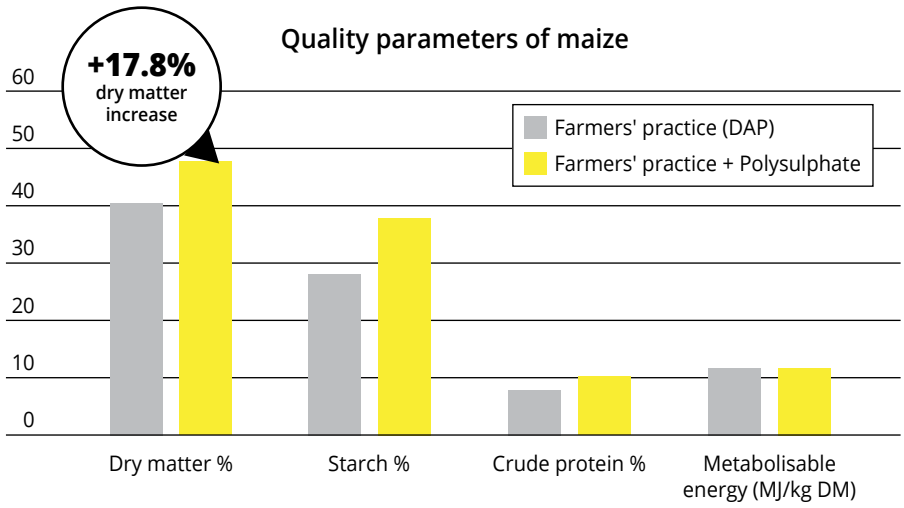
Objectives
To investigate the effect of the application of Polysulphate and DAP on the production of gas from maize grown for biogas.

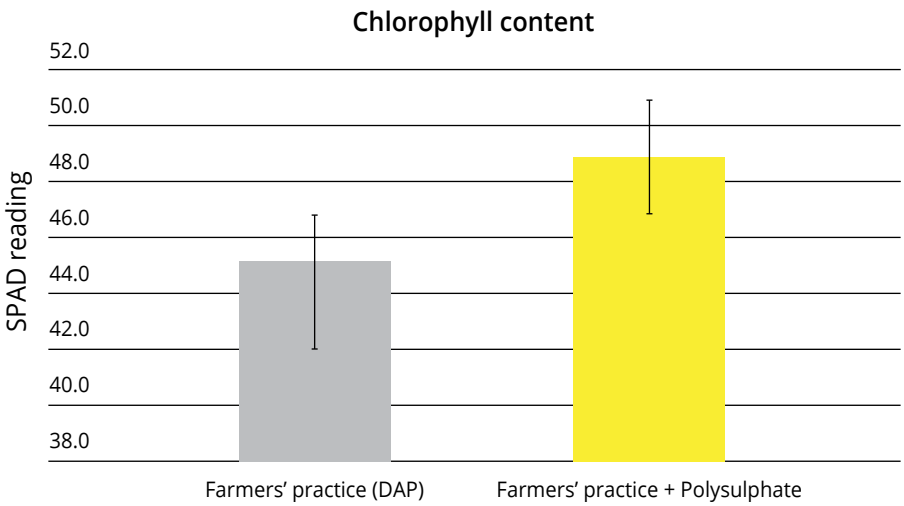
Treatments
The trial consisted of two fertilizer treatments for biogas maize. The control treatment followed standard practice, applying 125 kg/ha of DAP. In the second treatment, Polysulphate was applied at 67 kg/ha and DAP at 125 kg/ha.

Field layout



Results
- SPAD chlorophyll meter readings showed a significant increase in chlorophyll content when fertilized with Polysulphate.
- Polysulphate improved dry matter by 7.1% over the control.
- The overall yield, measured by the harvesting rigs, increased by 1.6 t/ha in the Polysulphate fertilized area, giving 5.6% more yield as compared with the farmers' practice.





Bars indicate average and standard errors

Polysulphate

Trial

Maize
Mexico

When
Planting: July 2018
Harvest:
January 2019

Where
Celaya, Guanajuato State, Mexico

Crop
Maize (*Zea mays* var. *Ocelote*)

Soil type
Vertisol, clay with neutral pH (7.5), low OM (1.5%) and high K, Ca, Mg, and Na content

Measurements
- Yield
- N and protein content in grain

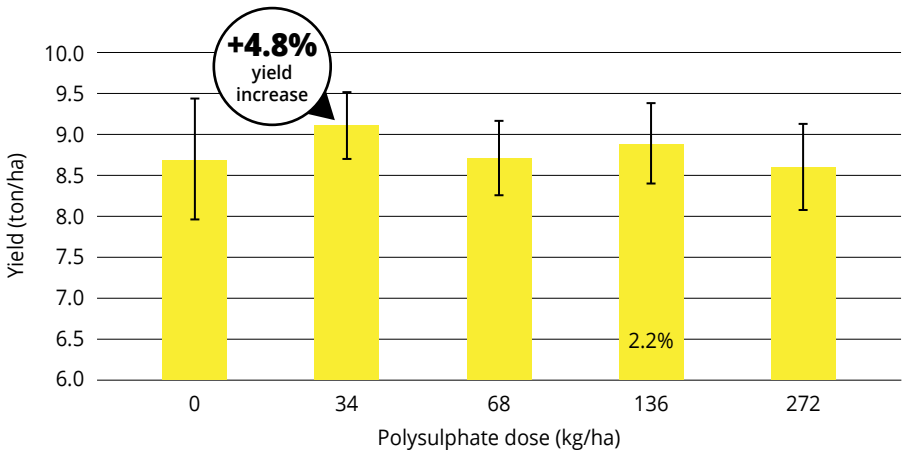
Bars indicate standard errors. Different letters indicate significant differences among treatments by Tukey test (P=0.05)

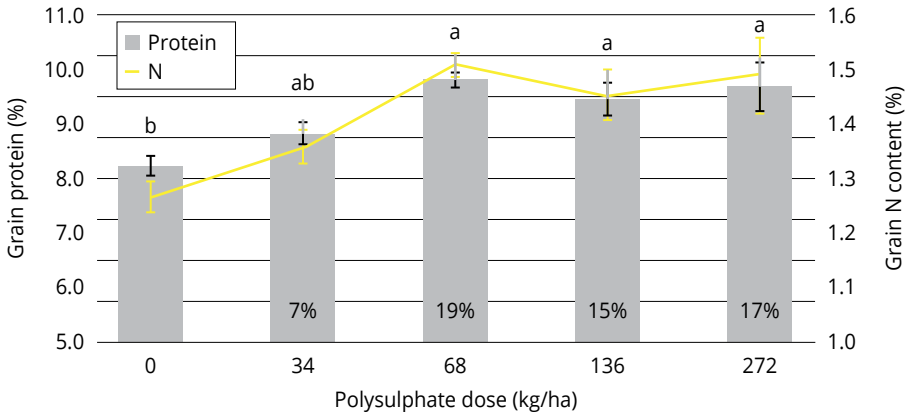
** From research funded by the International Potash Institute www.ipipotash.org.*

Objective
To evaluate the effect on maize yield and grain quality of using Polysulphate as a complementary K and S source, partially substituting KCl (MOP) fertilizer.

Treatments
This randomized block trial consisted of twenty plots with five Polysulphate doses (0, 34, 68, 136, and 272 kg/ha) applied incorporated at planting. All treatments received a total NPK application of 300, 100 and 50 kg/ha from urea, DAP and using Polysulphate as complementary K source that reduced the KCl application.

Results
- Late planting in the region resulted in low yields for all treatments and low response to Polysulphate in terms of maize yield (2.2-4.8%).
- A positive effect on protein and N content in maize grain was registered at Polysulphate application rates up to 272 kg/ha.
- Addition of S by Polysulphate improved N and protein contents in the grain from 7 to 19%.
- A recommended Polysulphate application rate of 100-150 kg/ha is suggested for the Guanajuato State region to improve maize productivity and grain quality.





Polysulphate

Trial

Mustard
India

When
Sowing:
November 2013
Harvest: March 2014

Where
Kanpur, Uttar Pradesh, India

Crop
Mustard *(Brassica juncea)*

Soil type
Sandy loam

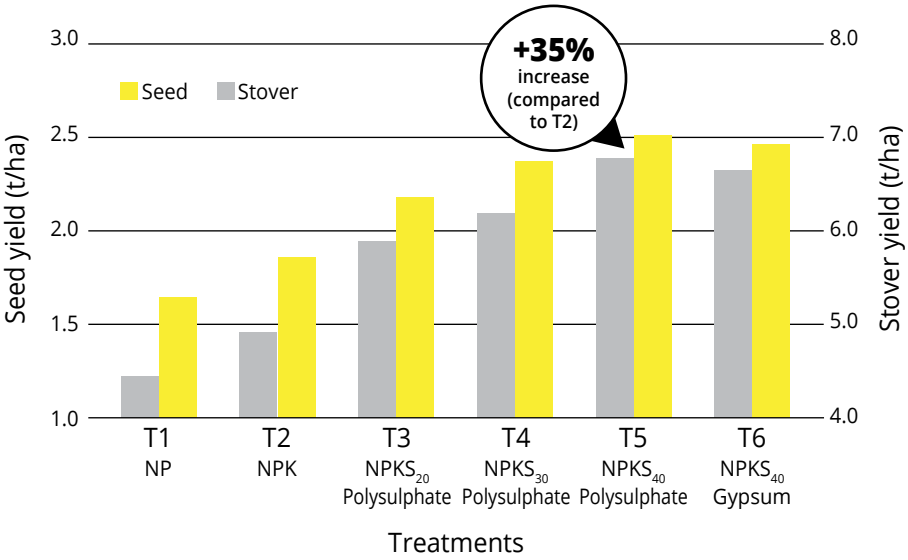
Measurements
- Yield
- Yield components
- Oil content
- Nutrient uptake

Objective
To test the efficacy of Polysulphate as a sulphur source on the performance of mustard crops in India.

Treatments
The experiment was laid out in a randomized block design with three replicates and included six treatments:
- T1: Control without S and K fertilization (100% NP through urea and DAP only)
- T2: 100% NPK (urea, DAP, Muriate of Potash (MOP))
- T3: 100% NP + 50% S through Polysulphate (20 kg S ha^{-1}) (balanced K through MOP to make 100% K)
- T4: 100% NP + 75% S through Polysulphate (30 kg S ha^{-1}) (balanced K through MOP to make 100% K)
- T5: 100% NP + 100% S through Polysulphate (40 kg S ha^{-1}) (balanced K through MOP to make 100% K)
- T6: 100% NPK (urea, DAP, MOP) + 100% S through gypsum (40 kg S ha^{-1}).

The recommended dose of fertilizers: 120 kg N, 60 kg P_2O_5, 60 kg K_2O ha^{-1} and 40 kg S ha^{-1} was applied as per the treatments. Full dose of P, K, S and half dose of N were applied at the time of sowing as a basal application. The remaining half dose of N was applied in two equal splits.

Results
- Mustard yield increased significantly and steadily in response to the increasing S dose applied through Polysulphate (T3-T5).
- Mustard seed yield at the maximum S dose, 40 kg ha^{-1} applied with Polysulphate (T5), increased by 35% compared with zero S application (T2).
- The response of oil yield to Polysulphate application was dramatic, providing 39% increase (T5 vs. T2). Sulphur applied through gypsum (T6) also gave rise to a significant increase in oil yields, although to a lesser extent than with Polysulphate.
- Yield components like pods per plant, pod length, seeds per pod and seed weight were highest at the maximum S level (T5).
- K and S uptake by mustard crop increased with increasing S dose applied through Polysulphate (T3-T5).



CD (P=0.05): 0.019 (seed); 0.018 (stover)

From research funded by the International Potash Institute www.ipipotash.org.

Polysulphate

Trial

Oilseed rape
UK

When
2018

Where
UK

Crop
Oilseed rape
(Brassica napus)

Soil type
Sandy clay loam

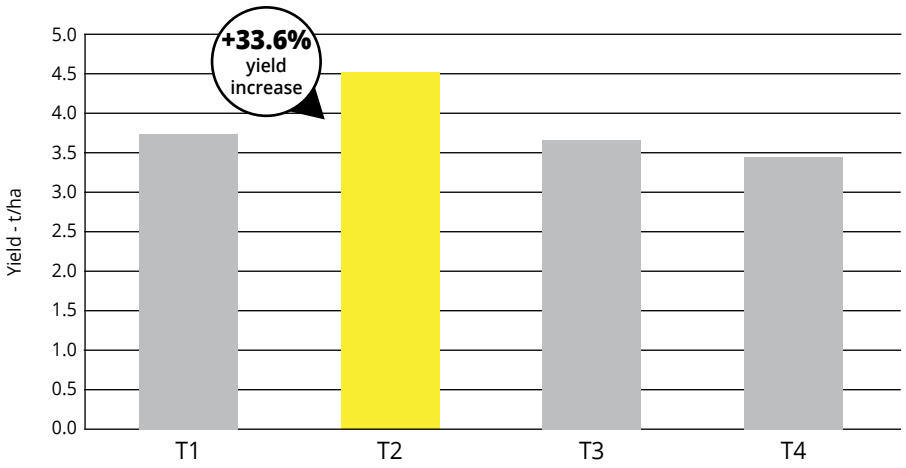
Measurements
Yield

Objective
In this trial we look at autumn and spring applications of sulphate to Winter Oilseed Rape (WOSR), primarily looking at yield with different timings of sulphur. We investigate split applications of S, how this can help with establishment of the crop, and winter hardiness.

Treatments
We looked at 3 different rates of application of Polysulphate on to WOSR. The whole field had a base fertiliser of 250 kg/ha 0-20-30. T1, T3 and T4 (farm practice) received 96 kg of SO_3 per ha in one single application. T2 received two applications of sulphate to the equivalent of 192 kg of SO_3, split 96 kg/ha at planting and 96 kg/ha early spring. All areas received 30 kg of nitrogen per ha at planting.

T1	T2	T3	T4
Polysulphate 200 kg/ha in the autumn (at planting)	Polysulphate 200 kg/ha in the autumn (at planting)		Ammonium sulphate applied to this area
	Polysulphate 200 kg/ha in the early spring	Polysulphate 200 kg/ha in the early spring	

Results
The application of Polysulphate increased the yield in all cases. Autumn and spring application increased the yield by an extra 1.15 t/ha over the farm practice.



Conclusion
In these results Polysulphate increased the yield between 200 kg/ha and 1.15 t/ha (T2 gave the best results). When we look at the return after fertiliser costs have been deducted we see that T1 gave an extra £62.94/ha, T2 gave an extra £291.70/ha and T3 gave an extra £21.60/ha over the control.

Polysulphate

Trial

Oilseed rape
China

When
Sowing:
September 21, 2016
Harvest: May 8, 2017

Where
Hubei, China

Crop
Winter oilseed rape
(Brassica napus)

Soil type
Sandy loam soil

Measurements
- Yield
- Yield components
- Nutrient uptake

Objective

To investigate the effect of increasing rates of Polysulphate on the yield, yield components and nutrient uptake of winter oilseed rape.

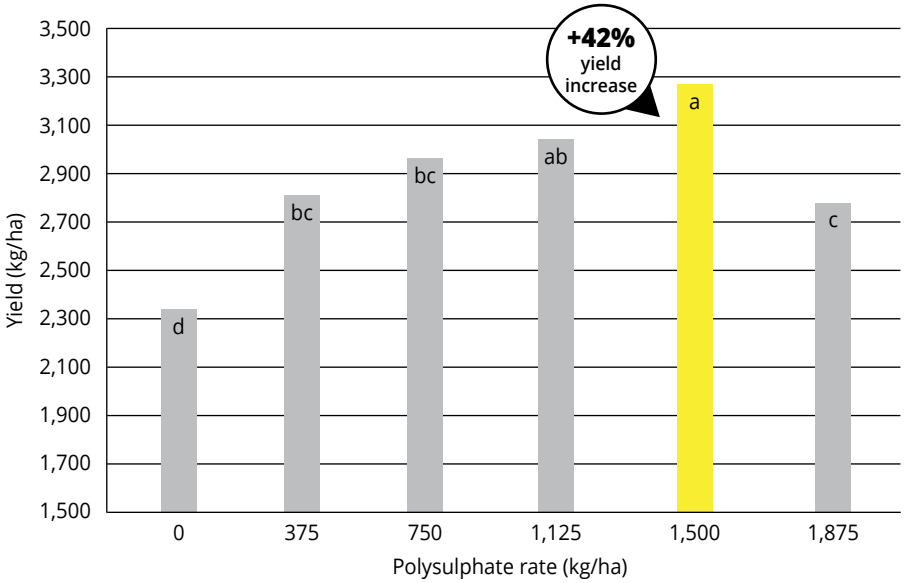
Treatments

This randomized block trial consisted of four replicates with six treatments. In all treatments, nitrogen, phosphorus and boron were applied according to farmers' traditional practice: 180 kg N/ha, 75 kg P_2O_5/ha and 1 kg B/ha. Five treatments consisted of increasing rates of Polysulphate: 375, 750, 1,125, 1,500 and 1,875 kg/ha. The control treatment received the same N, P and B application but no Polysulphate was applied.

Results

- All nutrients (N, P, K, S, Ca and Mg) uptake in shoots increased in the Polysulphate treatments when compared to the control. The highest nutrient uptake was obtained when Polysulphate was applied at a rate of 1,500 kg/ha.
- All three yield components (pods per plant, seeds per pot and 1000-seed weight) increased significantly with Polysulphate application, up to a dose of 1,500 kg/ha.
- Polysulphate application increased significantly the yield. The highest yield was obtained when Polysulphate was applied at a rate of 1,500 kg/ha.

Polysulphate (kg/ha)	N	P_2O_5	K	S	Mg	Ca
	Shoot uptake (kg/ha)					
0	83.1 d	7.5 d	100.5 e	29.3 e	12.2 e	36.9 e
375	105.1 c	11.5 c	170.5 d	51.8 d	15.9 d	54.2 d
750	115.1 ab	11.9 ab	255.2 c	66.6 bc	18.3 bc	66.8 bc
1,125	110.6 bc	12.0 bc	286.6 b	72.0 ab	19.1 b	72.3 ab
1,500	120.0 a	13.0 a	320.4 a	77.1 a	20.8 a	76.9 a
1,875	112.2 abc	12.3 abc	298.7 ab	64.6 c	17.3 c	64.1 c



Different letters above bars indicate significant differences among treatments ($p<0.05$).

Polysulphate

Trial

Oilseed rape
UK

When
2019

Where
North Yorkshire, UK

Crop
Oilseed rape
(*Brassica napus* cv. Phoenix)

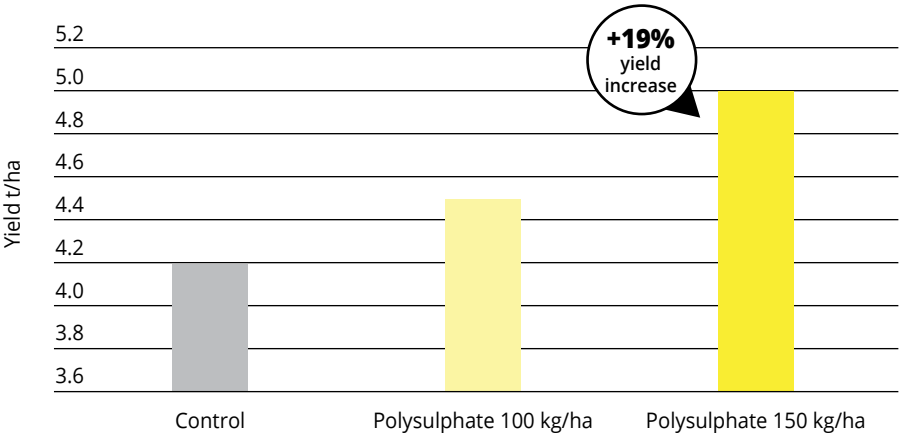
Soil type
Medium loam

Measurements
Yield

Objective
To investigate an autumn application of Polysulphate to supply sulphur at two different rates on the yield of oilseed rape variety Phoenix.

Treatments
- This is a split field trial
- Polysulphate was applied at 100 kg/ha and 150 kg/ha
- Both rates were broadcast at planting

Results
- Application of Polysulphate at 100 kg/ha and 150 kg/ha in the autumn significantly improved the yield of winter oilseed rape by 310 kg/ha and 820 kg/ha, on relatively high yielding crops.



Polysulphate

Trial

Oilseed rape
UK

When
2019

Where
North Yorkshire, UK

Crop
Winter oilseed rape *(Brassica napus* cv. Phoenix)

Soil type
Medium loam

Measurements
Yield

Objective

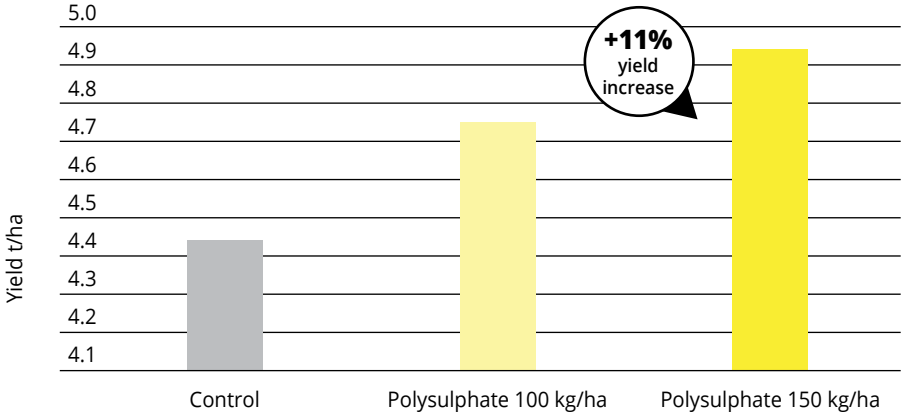
To investigate an autumn application of Polysulphate to supply sulphur at two different rates on the yield of oilseed rape variety Phoenix.

Treatments

- This is a split field trial
- Polysulphate was applied at 100 kg/ha and 150 kg/ha
- Both rates were broadcast at planting

Results

- Application of 100 kg/ha and 150 kg/ha of Polysulphate in the autumn significantly improved the yield of relatively high yielding winter oilseed rape by 310 kg/ha and 500 kg/ha, over the standard farm practice.



Polysulphate

Trial

Oilseed rape
UK

When
2019

Where
North Yorkshire, UK

Crop
Oilseed rape
(Brassica napus cv. Phoenix)

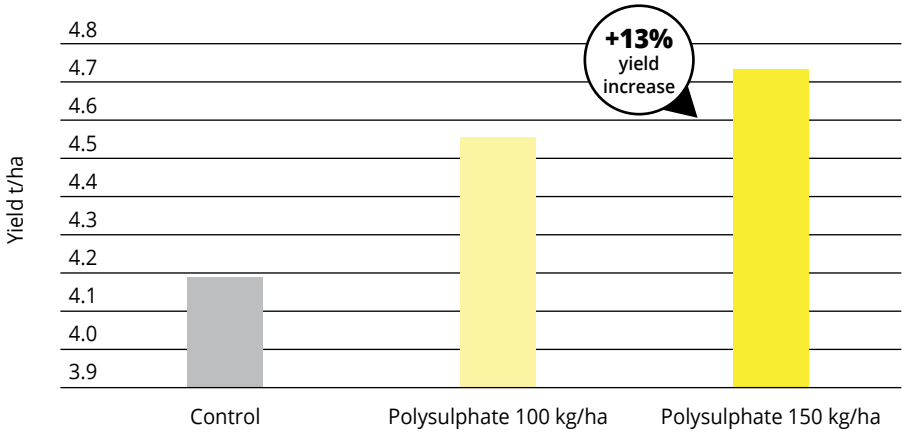
Soil type
Medium loam

Measurements
Yield

Objective
To investigate an autumn application of Polysulphate to supply sulphur at two different rates on the yield of oilseed rape variety Phoenix.

Treatments
- This is a split field trial
- Polysulphate was applied at 100 kg/ha and 150 kg/ha
- Both rates were broadcast at planting

Results
- Application of 100 kg/ha and 150 kg/ha of Polysulphate in the autumn significantly improved the yield of relatively high yielding winter oilseed rape by 370 kg/ha and 550 kg/ha over the standard farm practice.



Polysulphate

Trial

Oilseed rape
UK

When
2019

Where
South East UK

Crop
Oilseed rape
(Brassica napus cv. Mambo)

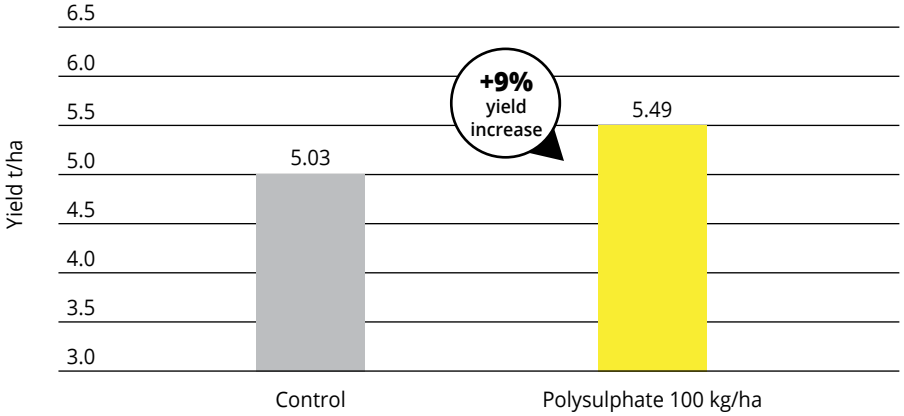
Soil type
Clay

Measurements
Yield

Objective
To investigate how an autumn application of sulphur from Polysulphate can increase yield by improving establishment before the winter.

Treatments
- This field was a split field trial
- Polysulphate was applied to the field at planting at a rate of 100 kg/ha, this supplies 48 kg sulphate (as SO_3), 14 kg potassium (as K_2O), 6 kg magnesium (as MgO) and 17 kg calcium (as CaO) per ha

Results
- Yield data and maps from the combine show that an extra autumn application of 100 kg/ha Polysulphate increased yield by an average of 263 kg/ha over the standard practice.



Polysulphate

Trial

Onion
Turkey

When
Sowing:
September 2016
Harvest: May 2017

Where
Antalya, Turkey

Crop
Onion *(Allium cepa)*

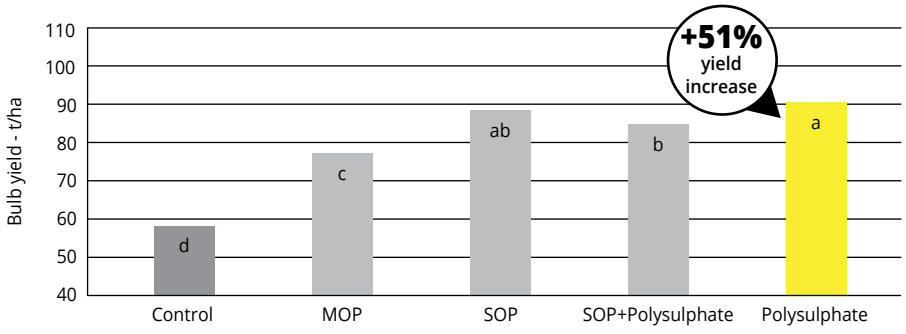
Soil type
Sandy loam soil

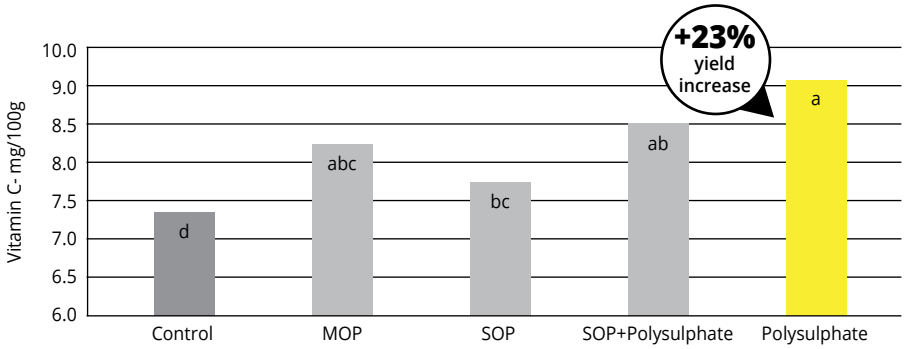
Measurements
- Bulb yield
- Quality parameters
- Nutrients uptake

Objective
To investigate the effect of Polysulphate, potassium sulphate (SOP) and potassium chloride (MOP, KCl) on the yield, quality parameters and nutrient uptake of onion.

Treatments
This randomized trial consisted of four replicates with five treatments. Nitrogen, phosphorus and potassium were applied according to target yield and soil tests at a rate of 200 kg N ha^{-1} (as urea and di ammonium phosphate, DAP), 170 kg P_2O_5 ha^{-1} (as di ammonium phosphate, DAP) and 270 kg K_2O ha^{-1} (as Polysulphate, SOP or MOP). An additional treatment consisted in K given 50% from SOP and 50% from Polysulphate. Control treatment received the same N and P doses but no K was applied.

Results
- Plant total uptake of N, P, K, Ca, Mg and S were highest in the Polysulphate treatment. Also micronutrients' uptake (Fe, Zn, Mn and Cu) were also significantly increased by Polysulphate application.
- Nutrients concentration in the bulb (P, K, Ca, Mg, S and Fe) were highest in the Polysulphate treatment.
- Polysulphate treatment resulted in the highest bulb yield significantly differing from the other treatments. Also bulb weight, bulb height and bulb diameter were highest at Polysulphate treatment.
- Polysulphate application increased the net return and was very profitable, with a B:C (benefit:cost ratio) of 21.2.
- The highest vitamin C concentration was found in the Polysulphate treatment. Polysulphate also increased antioxidant activity, phenols concentration and total soluble solids (TSS), which are very important parameters for onion quality.





Different letters above bars indicate significant differences among treatments ($p<0.001$).

From research funded by the International Potash Institute www.ipipotash.org.

Polysulphate
Trial

Onion
The Netherlands

When
Sowing: 20 April 2016
Harvest:
29 September 2016

Where
Nagele, Netherlands

Crop
Onion (*Allium cepa*)

Soil type
Clayey soil

Measurements
- Total bulb yield
- Bulb yield per category

Objective
Prove that the use of Polysulphate results in higher bulb yield and quality compared to current grower standard practices, potentially allowing for fewer nutrients to be applied obtaining greater yields and ultimately improving gross profit per acre.

Treatments
The rate of 360 kilograms per hectare of Polysulphate, a fertilizer approved for organic farming systems, supplied additional potassium, magnesium and calcium was compared with a control without no additional fertilizer applied.

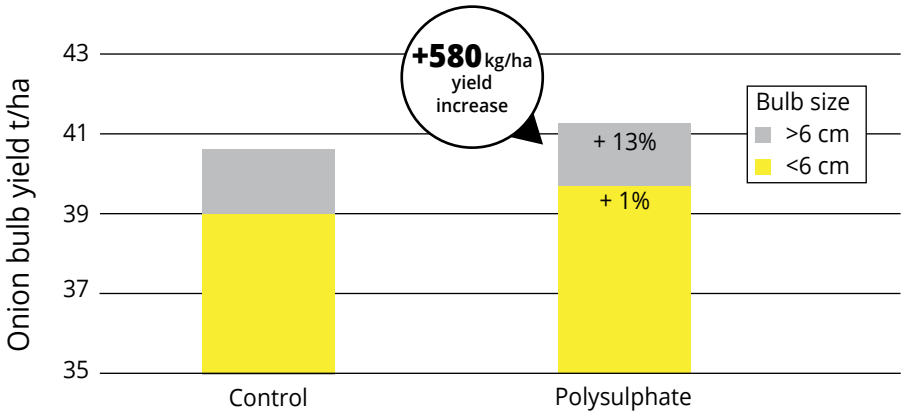
Onions are typically fertilized with organic wastes: protoamylase and vinasse, sub products of potato and sugar industries respectively, both rich in nitrogen and potassium.

An extra 50 kilograms per hectare of potash, as K_2O, 22 kg of Mg as MgO, 60 kg of Ca as CaO and 69 kg of S were supplied by the 360 kg/ha of Polysulphate.

Results
- Polysulphate increased total bulb yield by 580 kg/ha.
- Half of the higher yield was in larger bulb onions (> 6 cm diameter), increasing by 13%.

Bulb yield per size class (t/ha)

	<4 cm	4-6 cm	> 6 cm	Total
Control	4.9	34.1	1.6	40.56
Polysulphate	5.2	34.1	1.8	41.14
% to control	6%	0%	13%	1%
LSD 5%	1.6	3.7	1.3	3.9



Polysulphate

Trial

Pack Choi
China

When
Planting: 6 May 2016
Harvest:
30 June 2016

Where
Huaiyang County, Zhoukou City, Henan, China

Crop
Pack Choi (*Brassica rapa* subsp. chinensis)

Soil type
Fluvo-aquic soil

Measurements
- Spread
- Number of leaves
- Height of plant
- Weight per plant
- Yield

Different letters above bars indicate significant differences among treatments.

Research Partner
Cooperation between the Soil and Fertilizer Station of Henan Province and the Land and Fertilizer Mwanagement station of Zhoukou City.

Objective
To evaluate the addition of Polysulphate and sulphate of potash (SOP) to the farmers' practice on the yield and yield parameters ofpak choi crop grown in Henan Province, China.

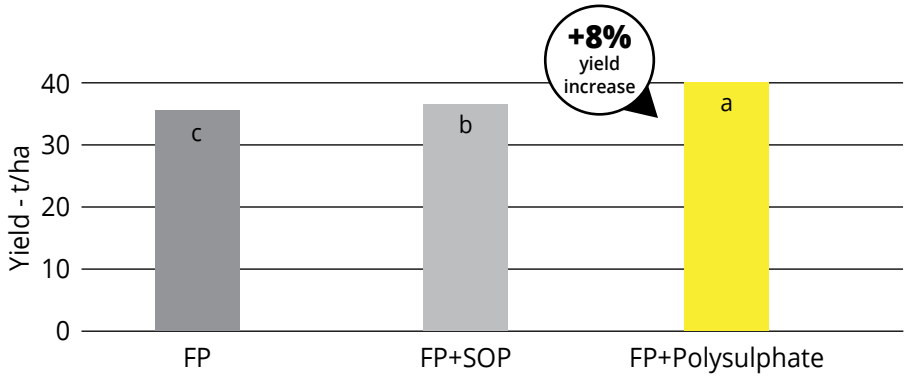
Treatments
In the trial there were three treatments with three replications arranged in random block design, the area of each plot was 30 m^2. Sowing rate was 3 kg /ha, Plant density in the field was 180,000 plants/ha.

1. Farmer practice (FP)
2. Farmer practice (FP) + 750 kg/ha of SOP
3. Farmer practice (FP) + 750 kg/ha of Polysulphate

Farmer practice: application of 750 kg/ha of 25-14-6 compound fertilizer as base fertilizer. Topdressing: 150 kg/ha of urea at fast growth stage.

Results

	Pak choi spread (cm)	Number of leaves per plant	Height of plant (cm)	Weight per plant (g)
FP	22.9	5.8	28	98.3
FP+SOP	22.7	6.0	29.1	100.5
FP+ Polysulphate	21.3	6.5	31.8	108.5



Conclusions
The application of Polysulphate on top of the farmers' practice, as compared with the addition of SOP and with the farmers' practice, increased plant height, leaf number per plant, single plant weight and yield.

Polysulphate

Trial

Pack Choi
China

When
Sowing: 8 May 2016
Harvest: 3 July 2016

Where
Liuzhuang village, Shangqiu City, Henan, China

Crop
Pack Choi (*Brassica rapa* subsp. *chinensis*)

Soil type
Fluvo-aquic soil

Measurements
- Spread
- Number of leaves
- Height of plant
- Weight per plant
- Yield

Objective
To evaluate the addition of Polysulphate and sulphate of potash (SOP) to the farmers' practice on the yield and yield parameters of pak choi crop grown in Henan Province, China.

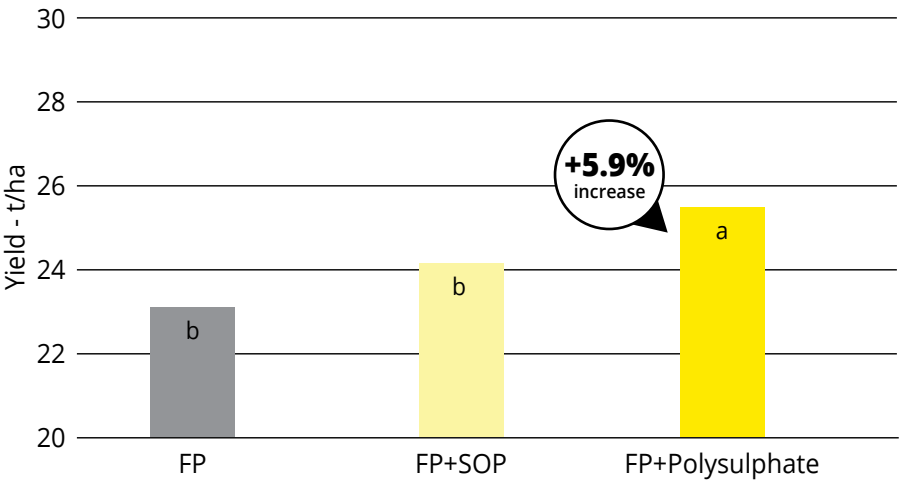
Treatments
In the trial there were three treatments with three replications arranged in a random block design, the area of each plot was 30 m^2. Sowing rate was 3 kg/ha, plant density in the field was 180,000 plants/ha.

1. Farmer practice (FP)
2. Farmer practice (FP) + 750 kg/ha of SOP
3. Farmer practice (FP) + 750 kg/ha of Polysulphate

Farmer practice: application of 600 kg/ha of 18-18-18 compound fertilizer as base fertilizer.

Results

	Number of leaves per plant	Height of plant (cm)	Weight per plant (g)
FP	7.9	20.6	143.8
FP+SOP	8.1	20.9	146.9
FP+Polysulphate	8.6	22.3	156.7



Conclusions
When comparing farmer's practice with the addition of either SOP or Polysulphate, the application of Polysulphate resulted in increased plant height, leaf number per plant, single plant weight and yield.

Different letters above bars indicate significant differences among treatments.

Research Partner
Cooperation between the Soil and Fertilizer Station of Henan Province and the Land and Fertilizer Management station of Shangqiu City.

Polysulphate

Trial

Vining peas
UK

When
Sowing: April 6, 2017
Harvest:
June 25, 2017

Where
PGRO Research Centre, England

Crop
Vining peas
(Variety Jubilee)

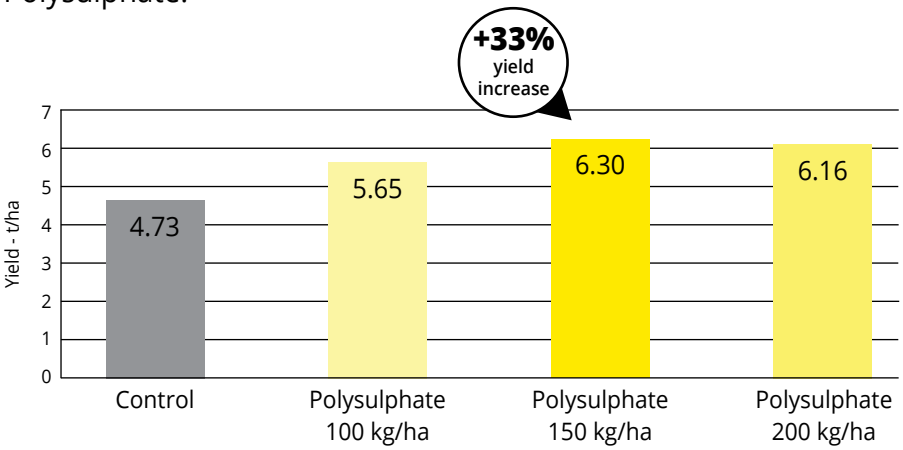
Soil type
Sandy clay loam

Measurements
Yield

Objective
To investigate the effect of different rates of Polysulphate on vining peas on a sandy clay loam soil.

Treatments
This was a randomised trial of four replicates with three different application rates of Polysulphate: 100, 150 and 200 kg/ha. Plot size was 1.5m x 10m.

Results
Polysulphate increased the yield in all three doses with the application rate of 150 kg/ha giving the greatest results: a 33% yield increase over the control. At 100 kg/ha and 200 kg/ha the yield increased by 19% and 30% respectively. Using a market price of £450/tonne for vining peas, the return on investment for the farmer is £684/ha (€773/ha) applying 150 kg/ha of Polysulphate.



Polysulphate

Trial

Peas
UK

When
2018

Where
Lincolnshire, UK

Crop
Peas (*Pisum sativum* cv. Amalfi)

Soil type
Light to medium deep silt

Measurements
- NDVI
- Yield

Objective

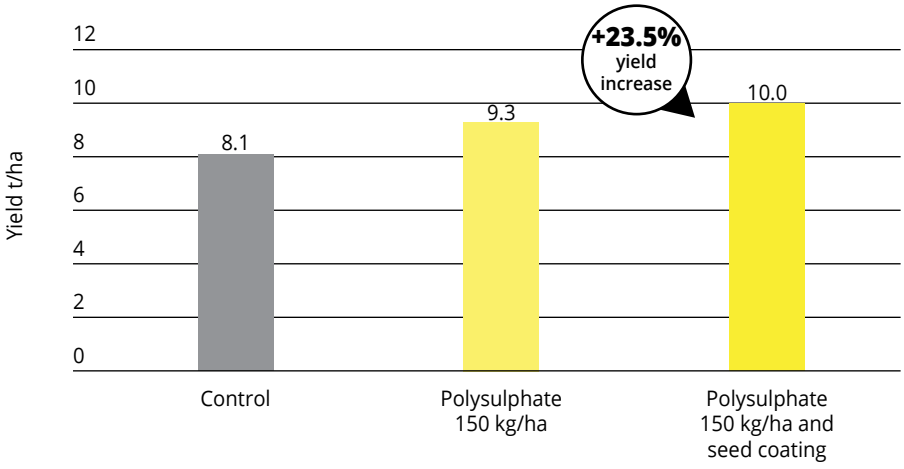
To investigate the effect of application of Polysulphate on vining peas. Specifically, to increase the yield and to see if seed rates are higher would this improve overall yield. The phased release of sulphate from Polysulphate should help with the formation of nitrogen fixing nodules in the roots of the pea crop.

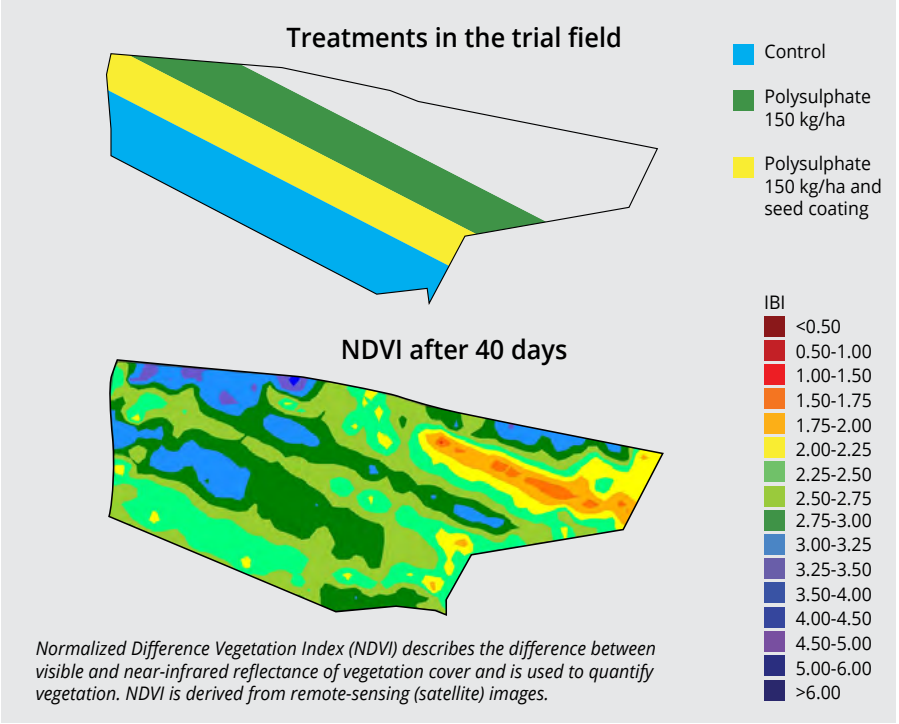
Treatments

- This trial was a split field trial
- Polysulphate was applied at a rate of 150 kg/ha at drilling

Results

- The average yield for the field was 8 t/ha when all areas were averaged. Polysulphate increased the yield by 1.2 t/ha over the standard farm practice and when the seed coating is added the yield improved to 1.9 t/ha over the control
- The satellite images had higher NDVI (green and blue colors) in the Polysulphate strips, thus showing denser vegetation than the farm practice





Normalized Difference Vegetation Index (NDVI) describes the difference between visible and near-infrared reflectance of vegetation cover and is used to quantify vegetation. NDVI is derived from remote-sensing (satellite) images.

Polysulphate

Trial

Combining peas
UK

When
Sowing: April 7, 2017
Harvest:
July 31, 2017

Where
PGRO Research Centre, England

Crop
Combining peas
(Variety Crackerjack)

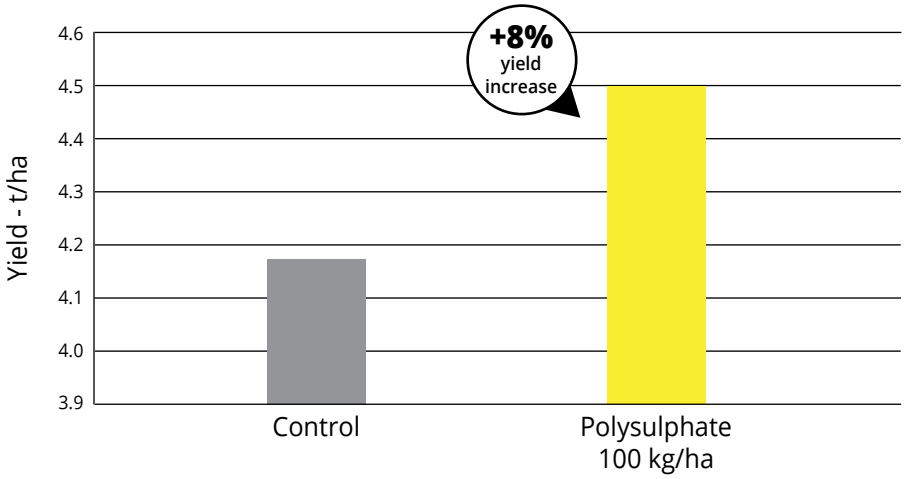
Soil type
Sandy clay loam

Measurements
Yield

Objective
To investigate the effect of different rates of Polysulphate on combining peas on a sandy clay loam soil.

Treatments
This was a randomised trial of four replicates that had three different application rates for Polysulphate: 100, 150 and 200 kg/ha. Plot size was 1.5m x 10m.

Results
Of the three Polysulphate application rates tested, the best result was achieved when Polysulphate was applied at 100 kg/ha. This resulted in a yield increased of approximately 8% (0.35 tonnes per hectare). Based on a market price of £180/tonne this represents an additional return of £62.28 per hectare.



Polysulphate

Trial

Peanut
Vietnam

When
Sowing: April 2016
Harvest:
September 2016

Where
Binh Dinh Province, Vietnam

Crop
Peanut *(Arachis hypogaea L.)*

Soil type
Sandy acidic soil

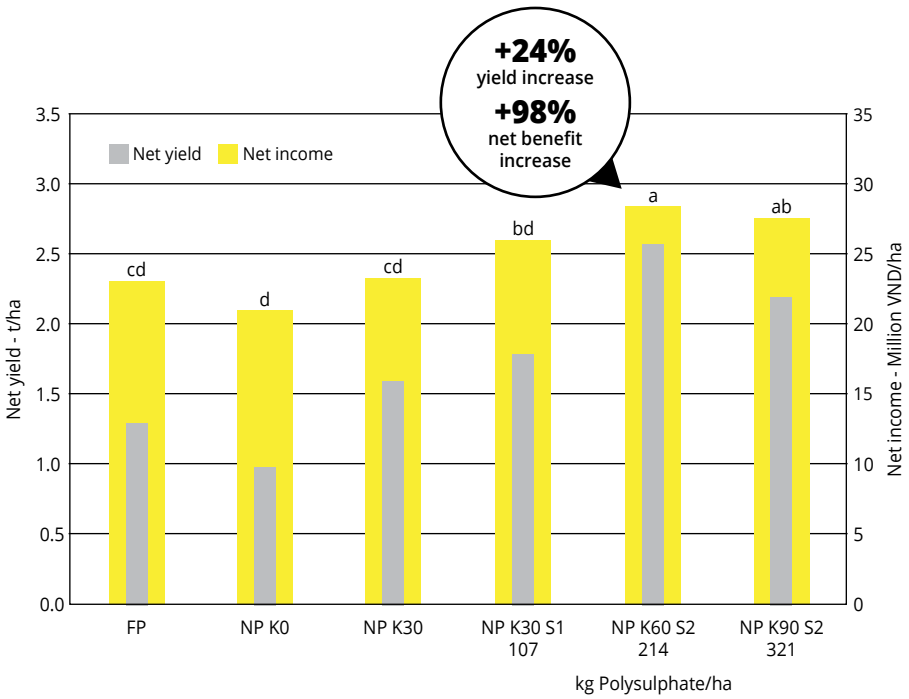
Measurements
- Yield
- Crop development
- Soil tests before sowing and after harvest

From research funded by the International Potash Institute www.ipipotash.org.

Objective
To evaluate the effects of potassium (K) and Polysulphate application rates on peanut agronomic and economic performances for the growing conditions in the Central Coast of Vietnam.

Treatments
The experiment was set according to a randomized complete block design (RCBD) with four replications. Six fertilization treatments were tested: Farmers' practice (FP) control, with N:P:K ratio of 95:40:100; NP-K_0, with 45 kg N/ha, 90 kg P_2O_5/ha, and zero K; and NP-K_{30}; NP-K_{30}-S_1; NP-K_{60}-S_2, and NP-K_{90}-S_3, all of which were applied with similar N and P rates, K rates increasing from 30 to 90 kg K_2O/ha, and Polysulphate at 107 (S_1, 25 kg S/ha), 214 (S_2, 50 kg S/ha), and 321 kg ha^{-1} (S_3, 75 kg S/ha), respectively. Nitrogen was applied through urea and P through superphosphate. Potassium was applied through KCl and Polysulphate.

Results
- FP and NP-K_0 displayed the poorest performance in most parameters tested and obtained low peanut yield and benefit.
- The optimum treatment was achieved with NP-K_{60}-S_2 (214 kg Polysulphate/ha), which resulted in a yield of 2.86 t/ha of grains, 24% more than the farmers' practice, and in a 98% increase in the net benefit to the farmer.
- Soil tests before sowing and after harvest, indicated that while FP significantly reduced soil fertility, Polysulphate led to enhanced soil fertility.



Polysulphate

Trial

Pineapple
Malaysia

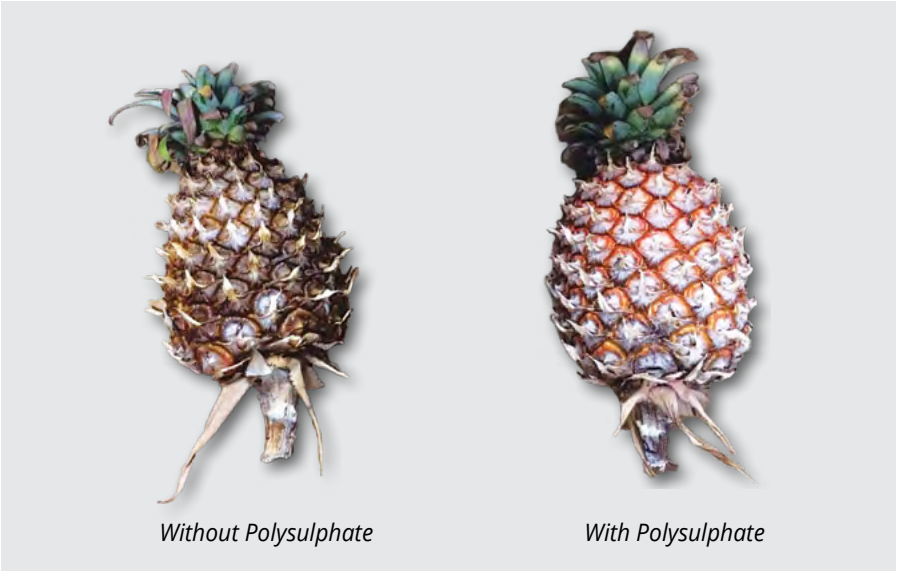
When
January 2017
to May 2017

Where
Simpang Renggam,
Johor, Malaysia

Crop
Pineapple (*Ananas comosus*)

Soil type
Peat

Measurements
- Yield
- Fruit grade



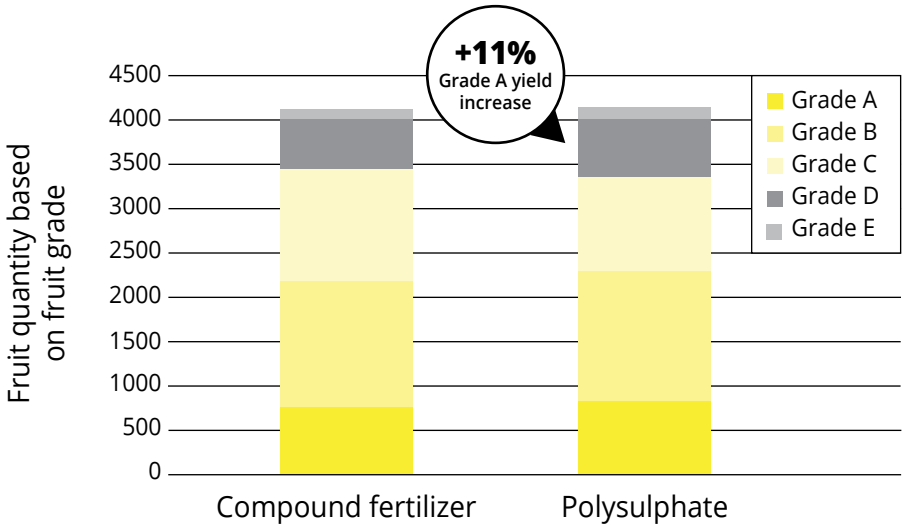
Without Polysulphate *With Polysulphate*

Objective
To determine the effectiveness of granular Polysulphate to improve the growth and yield of pineapples on peat soil.

Treatments

Treatment	Fertilizer	Rate
Control	Compound fertilizer (13-13-21+TE)	500 kg/ha
Polysulphate	Granular Polysulphate (0-0-14 +48% SO_3+6MgO +17CaO)	500 kg/ha

Results
- In the control plot, the majority of plants showed symptoms of K deficiency during the fruiting stage, while the plants in the Polysulphate plot had fewer K deficiency symptoms.
- Plants treated with Polysulphate had bigger leaves and fruit.
- Polysulphate application increased the sugar content in fruit: in control plots the Brix level was 13-16% compared to 16-19% with Polysulphate.
- Fruit from the Polysulphate plots had a longer shelf life.
- Total yield was similar for both plots, but there was an 11% increase in grade A fruits (> 660 g per piece) in the Polysulphate plot compared to the control plot.



Polysulphate

Trial

Pomegranate
China

When
2016

Where
Heyin, Henan Province, China

Crop
Pomegranate
(Punica granatum)

Soil type
Calcareous

Measurements
- Yield
- Number of fruits per tree
- Fruit weight
- Fruit quality

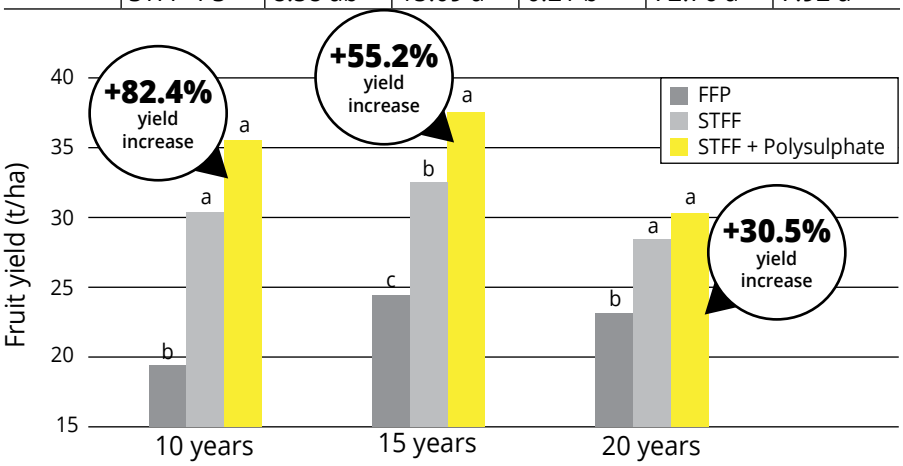
Objective
To compare the yield and quality of pomegranate fruits grown in Henan Province, China using farmers' fertilizer practice or fertilizer schemes based on soil tests and either with or without the addition of Polysulphate.

Treatments
The trial tested the effect of three different fertilizer treatments on pomegranate trees of either 10, 15, or 20 years old. There were three replications for each treatment.

1. FFP (farmer's fertilizer practice): base fertilizer in autumn: 7,500 kg/ha organic fertilizer; topdressing fertilizer in spring: 500 kg/ha N, 500 kg/ha P_2O_5 and 500 kg/ha K_2O
2. STFF (soil testing and formula fertilization): base fertilizer in autumn: 7,500 kg/ha organic fertilizer; topdressing fertilizer in spring: 373.5 kg/ha N, 223.5 kg/ha P_2O_5 and 327 kg/ha K_2O
3. STFF+PS (soil testing and formula fertilization + Polysulphate): base fertilizer in autumn: 7,500 kg/ha organic fertilizer and 375 kg/ha Polysulphate; topdressing fertilizer in spring: 373.5 kg/ha N, 223.5 kg/ha P_2O_5 and 327 kg/ha K_2O

Results
- Compared with farmers' fertilizer practice, using soil testing and formula fertilizers with Polysulphate significantly increased fruit yield for pomegranate trees of all ages. The yield increase is less significant as tree age increases, 82.4% (10 years), 55.2% (15 years) and 30.5% (20 years).
- Polysulphate significantly increased the number of fruits per tree, fruit weight and fruit size.
- Polysulphate significantly increased sugar content, sugar-acid ratio and vitamin C content, while decreasing acidity of the fruits.
- Compared with farmers' fertilizer practice, using soil testing and formula fertilizers with Polysulphate for pomegranate trees increased farmers' net income by 148.29%, 84.42% and 47.61% for 10, 15, and 20 year old trees respectively.

Tree-age (year)	Treatment	Diameter (cm)	Sugar Content (%)	Acidity (%)	Sugar acid ratio	Vitamin C content (mg/kg)
10	FFP	8.40 b	14.91 b	0.28 a	53.14 b	5.72 b
	STFF	8.84 a	15.10 ab	0.16 b	92.26 a	7.29 a
	STFF+PS	8.70 a	15.77 a	0.16 b	96.36 a	7.41 a
15	FFP	8.11 b	14.26 b	0.23 a	60.99 b	6.70 b
	STFF	8.34 ab	14.97 ab	0.19 ab	80.03 a	7.99 a
	STFF+PS	8.57 a	15.03 a	0.17 b	88.44 a	7.88 a
20	FFP	8.35 b	14.73 a	0.28 a	52.50 b	5.79 b
	STFF	8.67 a	14.66 a	0.18 b	81.50 a	7.85 a
	STFF+PS	8.58 ab	15.09 a	0.21 b	72.76 a	7.92 a



Different letters above bars indicate significant differences among treatments (P<0.05)

Polysulphate

Trial

Honey pomelo
China

When
Tree age: 5 years
Harvest:
October, 2017

Where
Fujian, China

Crop
Honey pomelo *(Citrus maxima)*

Soil type
Lateritic soil

Measurements
- Yield
- Fruit quality parameters
- Spring shoot parameters

Objective

To investigate the effect of Polysulphate on the yield, quality parameters and spring shoot parameters of honey pomelo.

Treatments

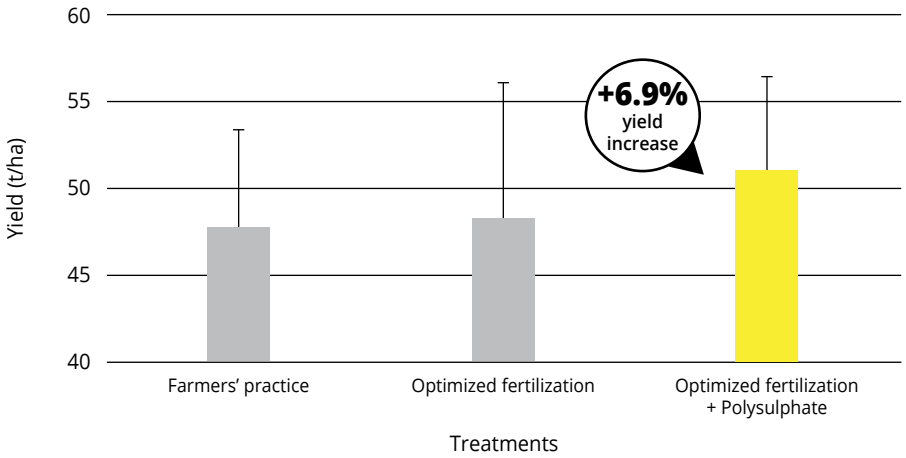
This trial consisted of three treatments with 12 plants per treatment. The treatments were: (1) farmers' practice (pig manure + NPK fertilizer at a total rate of 1,528, 1,016 and 1,246 kg/ha of N, P_2O_5 and K_2O respectively, split in 5 applications), (2) Optimized fertilization (organic fertilizer + NPK fertilizer at a total rate of 862, 631, 744, 69 and 49 kg/ha of N, P_2O_5, K_2O, CaO and MgO respectively, split in 4 applications), and (3) Optimized fertilization + Polysulphate (organic fertilizer + NPK fertilizer + Polysulphate at a total rate of 862, 631, 1038, 468 and 175 kg/ha of N, P_2O_5, K_2O, CaO and MgO respectively, split in 4 applications).

Results

- Compared with farmers' practice, Polysulphate application increased the number of spring shoots by 23% and the biomass of spring shoots by 19.7%.

- Polysulphate application increased the fruit yield by 6.9% when compared to the farmers' practice, and by 1.2% when compared to the optimized fertilization treatment.
- Polysulphate application increased the quality parameters, specially the fresh weight per fruit, flesh weight and fruit diameter.

- Compared with farmers' practice, Polysulphate treatment reduced the N, P and K inputs by 44, 38 and 17% respectively, thus decreasing fertilizer costs by 11% and increasing farmers' income by 7% when compared to farmers' practice.



Polysulphate

Trial

Potato
Colombia

When
Planting:
February 2018
Harvest: June 2018

Where
Totoró, Cauca,
Colombia

Crop
Potato *(Solanum tuberosum)*
Variety: Criolla

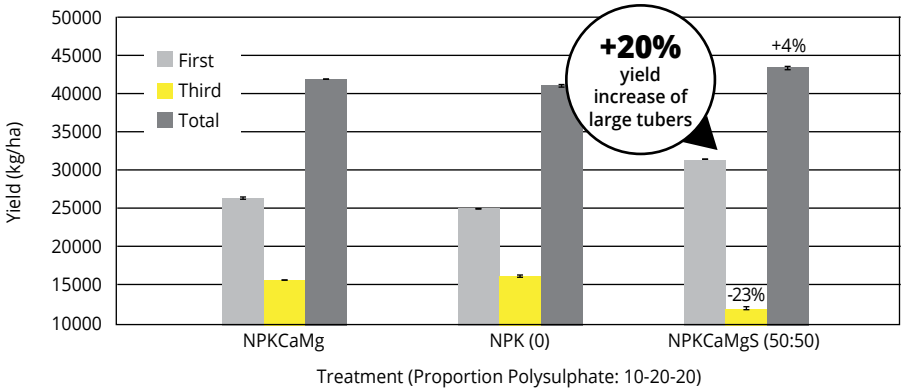
Soil type
Andisol, sandy loam

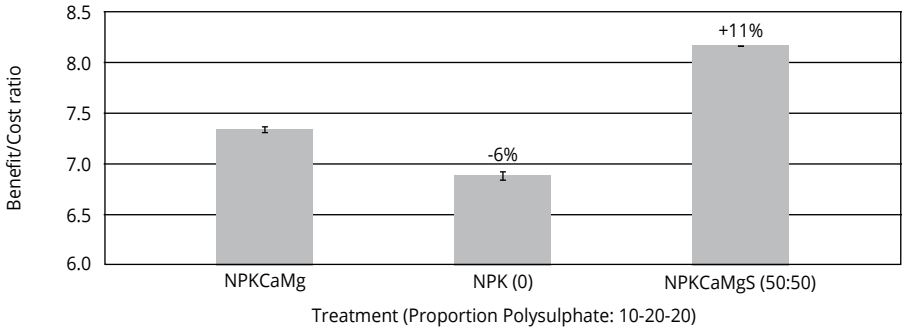
Measurements
- Yield
- Tuber size

Objective
To evaluate the effectiveness of partially replacing (up to 50%) the most common fertilizer (NPK 10-20-20) with Polysulphate to better balance the plants' nutrition, especially in terms of sulphur supply.

Treatments
A general fertilization with 900 kg/ha of a complex fertilizer (14-30-15 + 1Mg + 1Ca) was carried out at planting. Then, treatments were applied at 45 days after planting:
1) Farmers' practice: 900 kg/ha of a complex fertilizer (12-21-21 + 1.4Mg + 2.2Ca); 2) 900 kg/ha of an NPK fertilizer (10-20-20); and 3) 450 kg/ha of Polysulphate in combination with 450 kg/ha of 10-20-20 (50:50).

Results
- The combined Polysulphate and NPK treatment increased the total yield by 4% compared with the farmers' practice.
- The combined Polysulphate and NPK treatment resulted in an increase in the number of large tubers; 20% more first class (large) tubers and 23% less third class (small) tubers. This effect might be associated with higher proportions of Ca and Mg as well as the sulphur effect, which improves the N:S ratio.
- The combined Polysulphate and NPK treatment increased the total income by 13% compared with the farmers' practice.
- The combined Polysulphate and NPK treatment increased the benefit:cost ratio to 11% and constitutes a great option for farmers to improve the profitability of their crops, especially as increased tuber size provides greater access to markets at any time of the year.





Bars indicate average and standard errors

Polysulphate

Trial

Potato
China

When
Planting: 4 May, 2018
Harvest:
29 August, 2018

Where
Chayouzhong county, Inner Mongolia, China

Crop
Potato *(Solanum tuberosum)*
Variety: Kexin No.1

Soil type
Sandy loam, pH 8.0

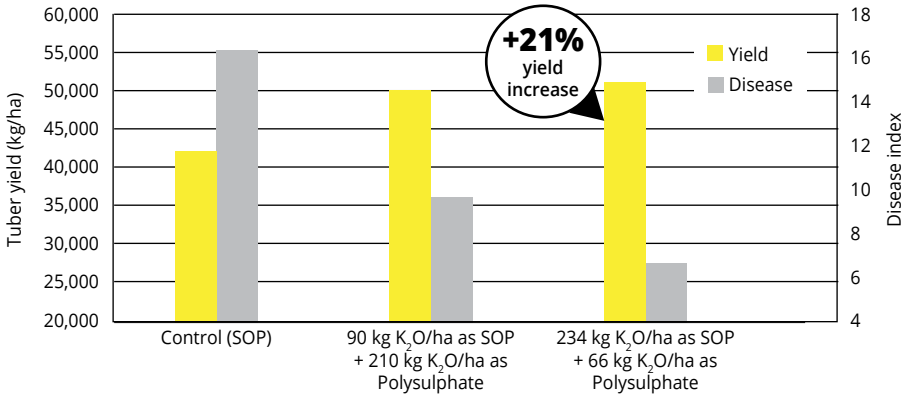
Measurements
- Yield
- Tuber size

Objective
To evaluate the effect of Polysulphate application in combination with sulphate of potash (SOP) on potato yield in China.

Treatments
The experiment was set according to a complete randomized block design with 3 replications. A K dose of 300 kg K_2O/ha was tested in different combinations of SOP and Polysulphate:
1) control, with 300 kg K_2O/ha as SOP;
2) 90 kg K_2O/ha as SOP combined with 210 kg K_2O/ha as Polysulphate and;
3) 234 kg K_2O/ha as SOP combined with 66 kg K_2O/ha as Polysulphate.

Nitrogen and P were applied at sowing for all treatments.

Results
- The combined treatment of 234 kg K_2O/ha as SOP combined with 66 kg K_2O/ha as Polysulphate increased the total yield by 21% when compared to the control. Tuber number per seedling was the highest at this treatment.
- Both the average tuber weight and the percentage of large tubers were increased by the combined application of Polysulphate and SOP when compared to SOP alone.
- The combined application of Polysulphate and SOP promoted starch accumulation in potato tuber, but did not affect the sugar content of tubers.
- The combined treatment of 234 kg K_2O/ha as SOP with 66 kg K_2O/ha as Polysulphate decreased the index of common scab disease from 16.4% in the control treatment to 6.7%.



Polysulphate

Trial

Potato
USA

When
Planting:
15 May, 2018
Harvest:
4 October, 2018

Where
Wisconsin, USA

Crop
Potato (*Solanum tuberosum* cv. Russet Burbank)

Soil type
Acidic, loamy sand soil

Measurements
- Yield
- Quality

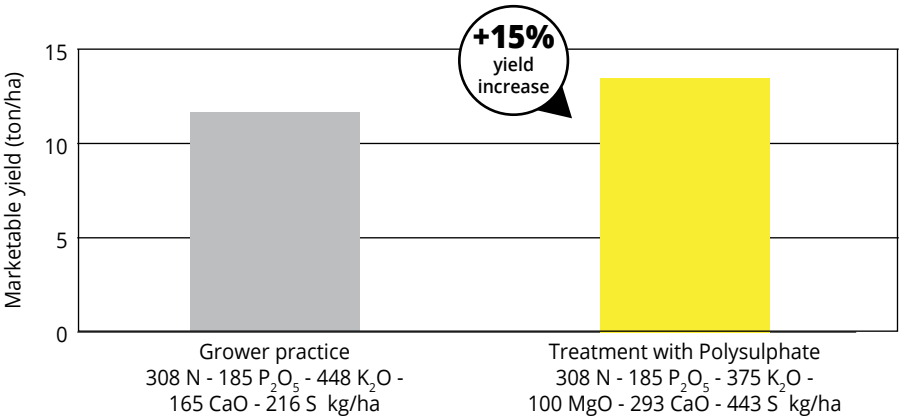
Objective
To evaluate Polysulphate as a substitute potassium, calcium, and sulphur from muriate of potash and gypsum in conventional practice, for potato 'Russet Burbank' grown in central Wisconsin.

Treatments
Grower practice consists of 37 kg N/ha applied at planting as DAP. At emergence and active growth, 85 and 190 kg N/ha was applied, respectively as ammonium sulphate and ammonium nitrate. Phosphorus, derived from DAP, was applied at 185 kg P_2O_5/ha at planting. Potassium was applied pre-plant at 310 kg K_2O/ha as MOP, and at 135 kg K_2O/ha as SOP at planting. In addition, at pre-plant gypsum was applied at 560 kg/ha.

The Polysulphate treatment was a duplicate of the grower practice without the pre-plant MOP and gypsum. Instead, Polysulphate was applied at 1,680 kg/ha at pre-plant.

Results
- Polysulphate fertilization increased the marketable ideal* yield by 1.79 ton/ha over conventional grower practice
- Marketable yield increased by 15% with the addition of Polysulphate

** The ideal yield is 6-16 oz or grades 2-4. Marketable yield excludes hollow tubers.*



Polysulphate

Trial

Potato
The Netherlands

When
2016

Where
Vredepeel, The Netherlands

Crop
Potato *(Solanum tuberosum)*

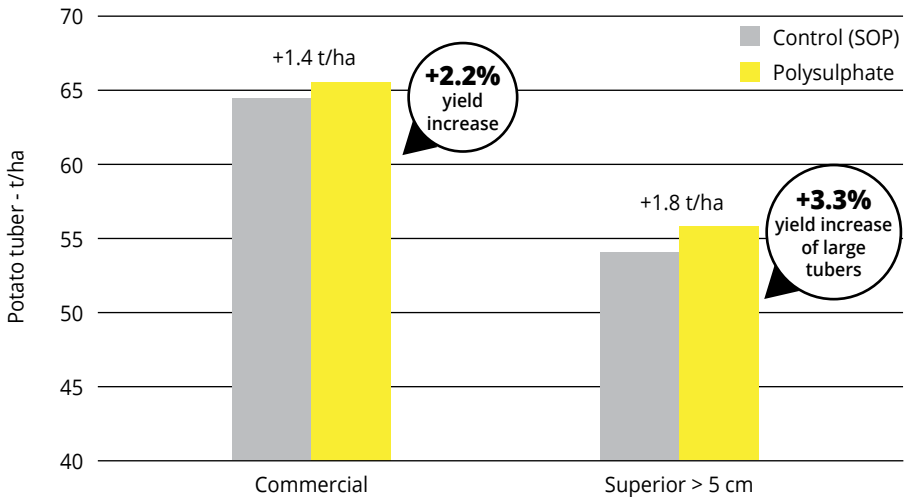
Soil type
Sandy soil

Measurements
- Tuber yield
- Tuber size

Objective
To prove that the use of Polysulphate results in higher tuber yield and quality of ware potatoes compared to current grower standard practices.

Treatments
- The use of Polysulphate at planting, at a rate of 1,053 kg/ha, was tested as a source of magnesium, a nutrient absent of the current standard practice.
- 65 kilograms per hectare of Mg as magnesium oxide (MgO), was supplied by Polysulphate.

Results
- The use of Polysulphate resulted in a significantly higher potato yield compared with the control (SOP) treatment.
- The larger significant differences were observed on marketable tubers (+2.2%), and especially with larger tubers (+3.3%).
- No significant effect was observed on tuber density, an indicator of industrial quality.



Polysulphate

Trial

Potato
Greece

When
Planting: April 2019
Harvest:
October 2019

Where
Kozani, Greece

Crop
Potato *(Solanum tuberosum)* cv. Spunta

Soil type
Clay soil

Measurements
Yield

Objective

This trial in Northern Greece compared the yield of potatoes grown with an improved ICL fertilizer package, which included Polysulphate, to potatoes grown using the standard local farmers' practice.

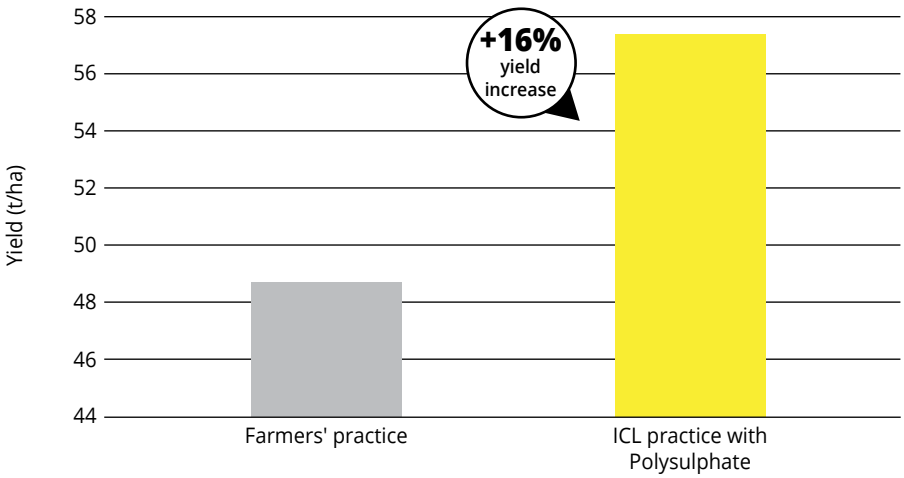
Treatments

The farmers' practice consisted of a basal application of 1,100 kg/ha of compound fertilizer 14-14-14+26SO_3+ 2MgO; a top dressing of 300 kg/ha of potassium-magnesium sulphate (0-0-30+42SO_3+10MgO) and 200 kg/ha of 40-0-0+14SO_3; 80 kg/ha of 20-19-19 and 80 kg/ha of 12-6-36+TE applied through fertigation; and 2.5 kg/ha of 3-27-18+seaweed applied as a foliar sprayed. In total 259.6 kg N/ha, 174 kg P_2O_5/ha, 288 kg K_2O/ha, 440 kg SO_3/ha and 52 kg MgO/ha were applied to the crop.

The improved ICL practice included the same basal fertilization; a top dressing of 500 kg/ha of Polysulphate and 200 kg/ha of 40-0-0+14SO_3; and 100 kg/ha of ICL "Solinure" 11-35-11+2MgO+TE and 250 kg/ha of ICL "NovaNPK" 10-10-40+TE applied through fertigation. In total 270 kg N/ha, 214 kg P_2O_5/ha, 335 kg K_2O/ha, 554 kg SO_3/ha, 54 kg MgO/ha and 85 kg CaO/ha were applied to the crop.

Results

- The improved Polysulphate practice increased potato yield by 16%.
- Net income for the potato grower using the improved practice increased by 15% when compared to the standard practice.



ICLPotashpluS

Trial

Potato
UK

When
2017

Where
North Yorkshire, UK

Crop
Potato *(Solanum tuberosum)*

Soil type
Loam

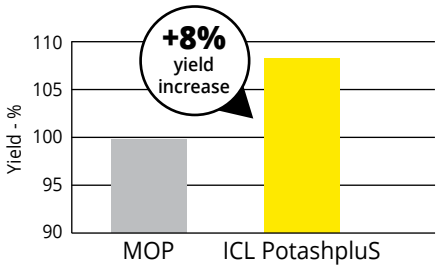
Measurements
- Yield
- Tuber dry matter (% DM)

Objective
To investigate how ICL PotashpluS compares to muriate of potash (KCl, MOP) as a source of potassium for processing potatoes.

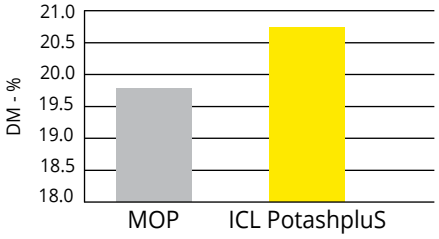
Treatments
- This was a split field trial.
- ICL PotashpluS and MOP were applied to provide the same application rate of potassium: 340 kg K_2O/ha.
- Both fertilisers were broadcast and incorporated prior to planting.

Results
- ICL PotashpluS gave a 8% increase in yield over the MOP. This is attributed to the soluble magnesium, sulphur and calcium supplied by ICL PotashpluS, even when the soil was not magnesium deficient.
- The tuber dry matter was higher in the ICL PotashpluS treatment (20.6%) than where MOP was applied (19.8%). Dry matter is a valuable benefit for processing potatoes.
- The ICL PotashpluS tubers were judged to be more consistent in size, showing less variation.

Tuber yield increase



Tuber dry matter



Polysulphate

Trial

Potato
Peru

When
Planting: July 2017
Harvest:
December 2017

Where
Huancabamba, Piura State, Peru

Crop
Potato (*Solanum tuberosum* var. *Amarilis*)

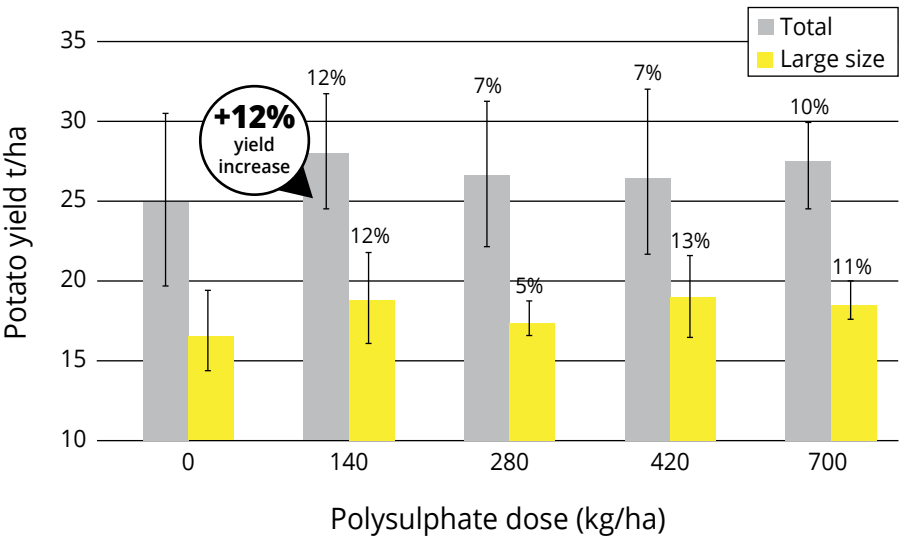
Soil type
Andisol, clay loam

Measurements
- Total yield
- Yield class based on tuber size

Objective
To evaluate the effect of Polysulphate as a complementary K and S source on potato yield and tuber size.

Treatments
This trial was established under a randomized block design with 4 replications and included five split Polysulphate doses (0, 140, 280, 420, and 700 kg/ha) applied and incorporated at planting and earthing up 45 days later. All treatments received a total NPK application of 250, 150 and 200 kg/ha from urea, DAP and KCl, using Polysulphate as a complementary K source that reduced the KCl.

Results
- A positive effect on yield and tuber size up to 700 kg/ha of Polysulphate was observed.
- Polysulphate significantly increased total yield by 7 to 12% compared to the control without Polysulphate.
- Addition of S from Polysulphate improved tuber size by 5 to 13%.
- The recommended application rate for potato production in Huancabamba State is 300-400 kg/ha of Polysulphate plus an extra MgO dose of 30 Kg/ha.



Bars indicate standard errors of the four replications of each treatment

** From research funded by the International Potash Institute www.ipipotash.org.*

Polysulphate

Trial

Sweet potato
USA

When
Sowing: May 2019
Harvest:
September 2019

Where
Kenly,
North Carolina, USA

Crop
Sweet potato
(Ipomoea batatas)

Soil type
Sandy loam soil

Measurements
Yield

There are 56 #1 potatoes in a bushel

Objective

To compare the effect on sweet potato yield of replacing the farmers' practice fertilizer blend with a blend which contains Polysulphate, in North Carolina, USA.

Treatments

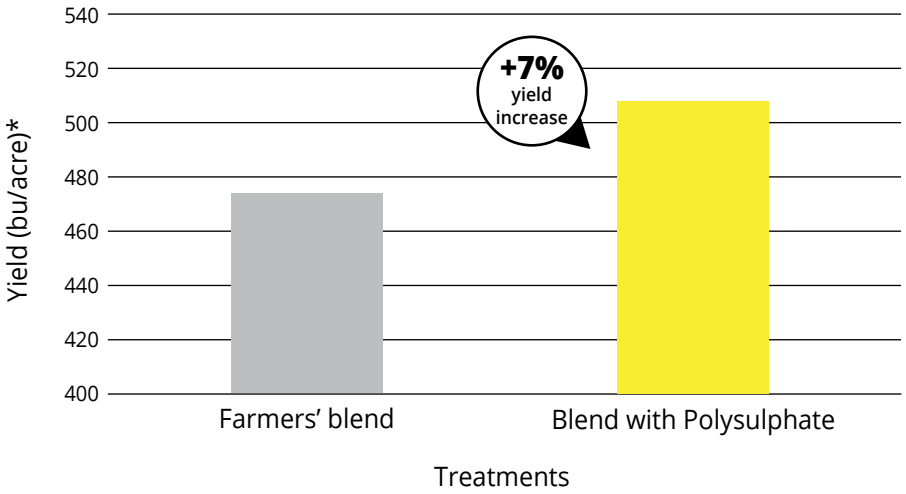
Farmers' practice consisted of a blend of DAP, MOP and potassium-magnesium sulfate, giving a dose of 21 lbs. N, 55 lbs. P_2O_5, 200 lbs. K_2O, 15 lbs. S and 7 lbs. Mg per acre.

The Polysulphate treatment consisted of a blend of DAP, MOP and Polysulphate, giving a dose of 23 lbs. N, 58 lbs. P_2O_5, 200 lbs. K_2O, 51 lbs. S, 9 lbs. Mg and 33 lbs. of Ca per acre.

These blends we applied two weeks after setting. Both treatments had liquid UAN (urea ammonium nitrate) side-dressed at mid-season.

Results

- Compared with farmers' fertilization practice, using a blend with Polysulphate increased sweet potato yield by 7% and increased #1s by 30 bushels/acre.
- The results showed that with equal amounts of N, P, and K there is a benefit from Polysulphate due to the higher rate of plant-available sulfur and calcium. Also, the prolonged availability of the nutrients in Polysulphate may contribute to the enhanced yields.



Polysulphate

Trial

Potato
Colombia

When
Planting:
September 2018
Harvest: April 2019

Where
Totoró, Cauca State, Colombia

Crop
Potato (*Solanum tuberosum* var. Parda)

Soil type
Andisol, sandy loam

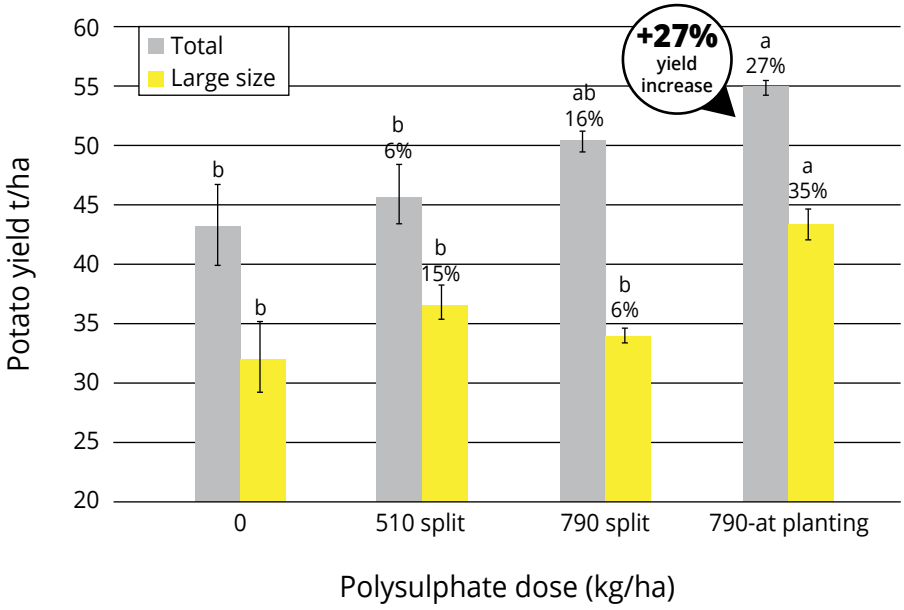
Measurements
- Total yield
- Yield class based on tuber size

Objective
To evaluate the effect of Polysulphate, applied in one and two applications, as a complementary nutrient source on potato yield and tuber size.

Treatments
This trial consisted of twenty rows, each established with one of four Polysulphate treatments. Polysulphate was applied and incorporated at planting and 45 days later at earthing up in 4 treatments: 1) No Polysulphate; 2) 510 kg/ha split at planting and earthing up; 3) 790 kg/ha split at planting and earthing up; 4) 790 kg/ha at planting.

All treatments received a total NPK application of 210, 400 and 290 kg/ha, using Polysulphate as a complimentary K source that reduced the other K sources (12-24-12 and 12-21-21).

Results
- A positive trendline of yield and tuber size with increasing doses of Polysulphate up to 790 kg/ha was observed.
- Polysulphate significantly increased total yield up to 27% compared to the control with no Polysulphate.
- Addition of K, Ca, Mg and S from Polysulphate improved tuber size by 6 to 35%.
- A split dose would normally perform better, but due to the dry conditions during the trial, the single application of 790 kg/ha at planting resulted in higher yields compared to the same split dose.
- The recommended application rate for potato production in Cauca State is 500-600 kg/ha of Polysulphate.



Bars indicate standard errors of the four replications of each treatment

Different letters indicate significant differences among treatments by Tukey test (P=0.05)

Polysulphate

Trial

Potato
USA

When
Planting:
May 15, 2018
Harvest:
October 4, 2018

Where
AgRes, LLC
Hancock Wisconsin,
USA, David Wenner

Crop
Potato (*Solanum tuberosum* cv. Russet Burbank)

Soil type
Acidic, loamy sand soil

Measurements
- Yield
- Quality

Objective
Evaluate Polysulphate as substitute for the potassium, calcium, and sulfur from muriate of potash and calcium sulfate in conventional practice, for potato 'Russet Burbank' grown in central Wisconsin.

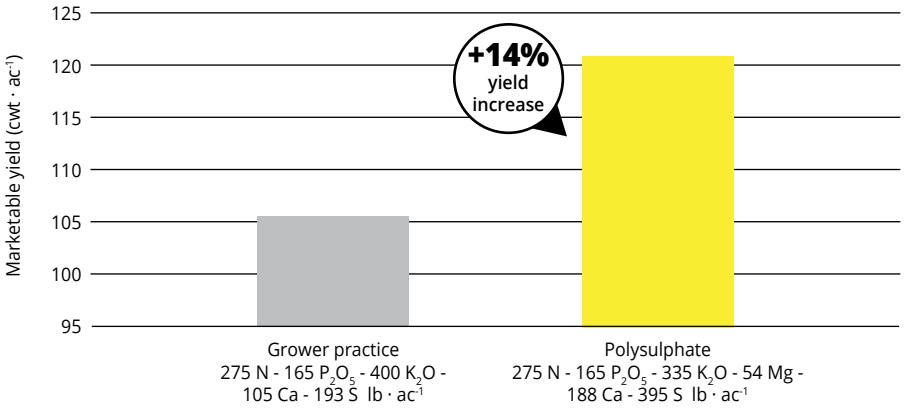
Treatments
Size 'B' Russet Burbank potato seed were planted at a rate of 14,520 seeds per acre at a 6-inch depth with 12 inches in row and 36 inches between row spacing. The potatoes were harvested at a 6-foot width using a 1 row potato digger.

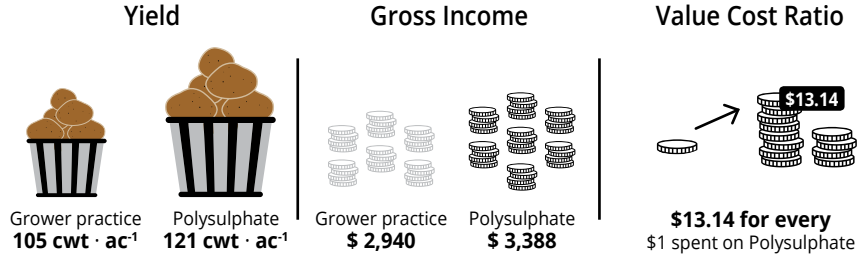
For grower practice per acre nitrogen was applied at 33 pounds at planting, 76 pounds at emergence, 119 and 51 pounds during active growth derived from DAP, AS, and ammonium nitrate, respectively. Phosphate was applied at 165 pounds per acre at planting derived from DAP. Per acre potassium (K_2O) was applied as 276 pounds pre-plant, and 121 pounds at planting and was derived from MOP, and MOP with SOP, respectively. In addition, gypsum was applied pre-plant at 500 pounds per acre.

The Polysulphate treatment was a duplicate of the grower practice without the pre-plant MOP and gypsum. Polysulphate was applied at 1500 pounds per acre pre-plant supplying 334 pounds per acre K_2O, and the full season's supply of calcium and sulfur.

Results
- Polysulphate fertilization increased the marketable ideal* yield by 16 hundredweight per acre over conventional grower practice
- Yield to fertilizer ratio for nitrogen increased by 14% with the addition of Polysulphate
- The value cost ratio of adding Polysulphate was $13.14 for every $1 spent
- Gross income per acre increased by $448 with the addition of Polysulphate

** The ideal yield is 6-16 oz or grades 2-4. Marketable yield excludes hollow tubers.*





Polysulphate

Trial

Potato
The Netherlands

When
Planting: May 2016
Harvest:
October 2016

Where
Lelystad, The Netherlands

Crop
Potato
(*Solanum tuberosum*)

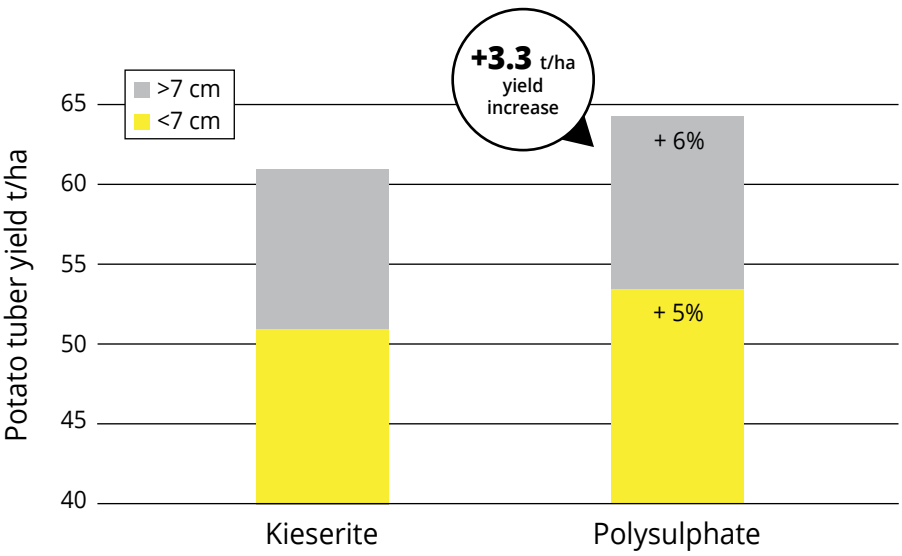
Soil type
Clayey

Measurements
Tuber yield

Objective
Prove that the use of Polysulphate results in higher tuber yield and quality compared to current grower standard practices.

Treatments
- The use of Polysulphate was compared with kieserite to supply magnesium, the current standard practice.
- 47 kg/ha of Mg as magnesium oxide (MgO), was supplied by both sources.
- The rate of 791 kg/ha of Polysulphate, supplied additional potassium and calcium that were compared with the control with kieserite.

Results
- The use of Polysulphate resulted in a significantly higher potato yield when used as Mg source instead of kieserite.
- Increased total bulb yield by 3.3 t/ha.
- Higher yield was found in every class grade yield, as well as in number of tubers, increasing by 5%.
- No significant effect on tuber density, as indicator of industrial quality.



Polysulphate

Trial

Rice
USA

When
Planting:
March 15, 2018
Harvest:
July 25, 2018

Where
LSU AgCenter Rice Research Station, Rayne, Louisiana, USA

Crop
Rice *(Oryza sativa)*

Soil type
Sandy, silt-loam soil

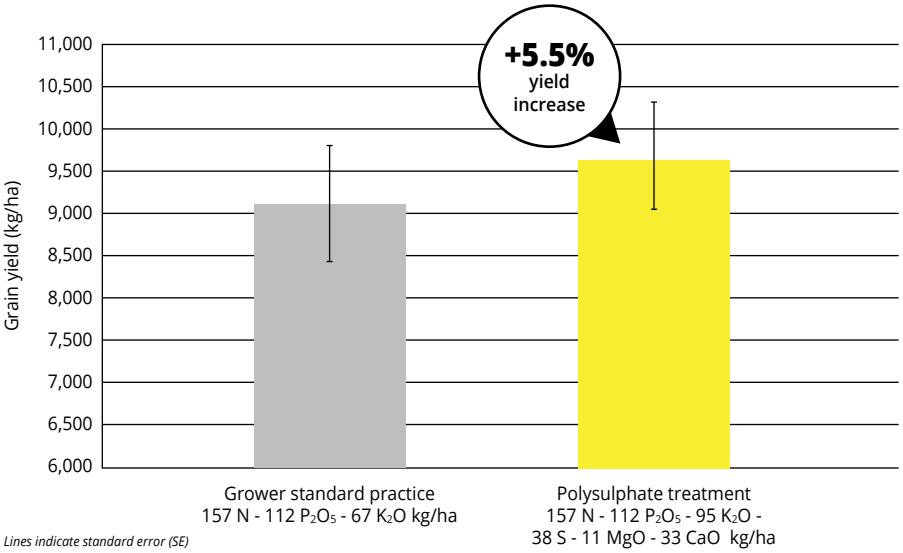
Measurements
Yield

Objective
To evaluate Polysulphate as a fertilizer source for 'CL153' rice grown in sandy, silt-loam soils in southern Louisiana, USA.

Treatments
This trial compared rice grow using grower standard practice, and grower standard practice with Polysulphate.

Grower standard practice consisted of 157 kg N/ha in the form of urea, 112 kg N/ha at pre-flood, and 45 kg N/ha at green ring. Phosphorus was applied pre-flood at 112 kg P_2O_5/ha from DAP and Super PK. Potassium was applied pre-flood at 67 kg K_2O/ha per acre from Super PK. The Polysulphate treatment was a duplicate of the grower standard practice with the addition of 196 kg Polysulphate/ha applied pre-flood.

Results
- Polysulphate increased rice yield by 534 kg/ha (5.5%) over grower standard practice.



Lines indicate standard error (SE)

Polysulphate

Trial

Rice
Ecuador

When
Planting: September 2018
Harvest: February 2019

Where
Yaguachi, Guayas, Ecuador

Crop
Rice (*Oryza sativa* var. *INIAP FL Cristalino*)

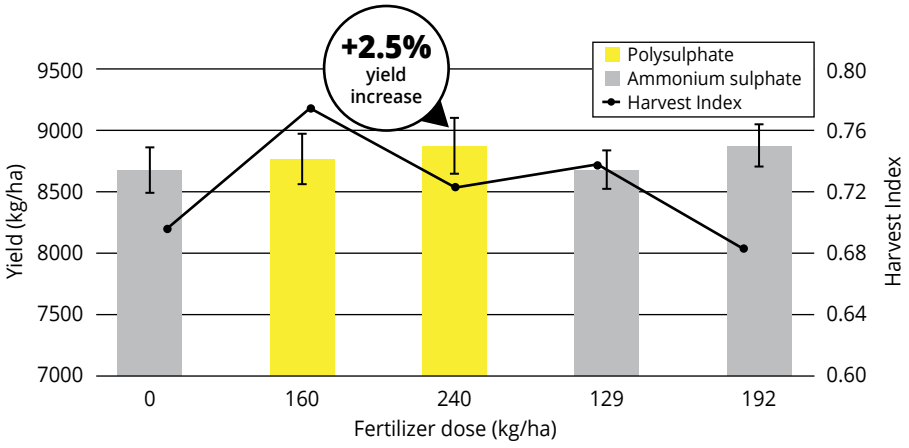
Soil type
Inceptisol, loam with neutral pH (6.9), low OM (1.2%) and high K, Ca, Mg, and Na content.

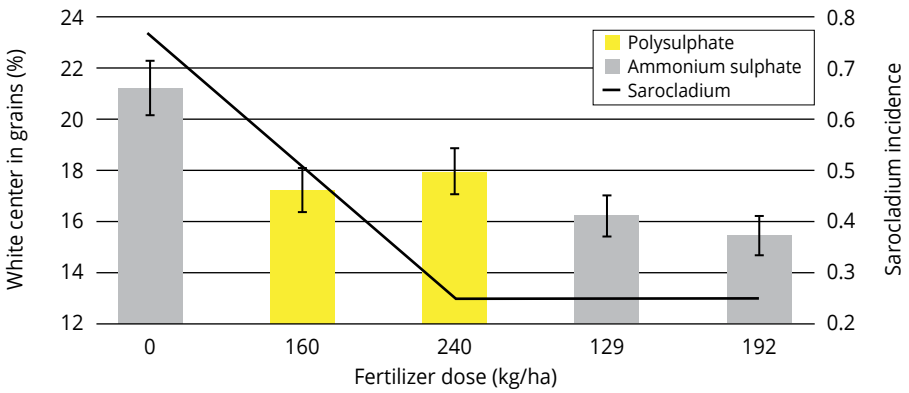
Measurements
- Yield and Harvest Index
- White center presence in grains and Sarocladium (sheath rot) incidence

Objective
To evaluate the effect of Polysulphate, as a complementary K and S source partially substituting KCl (MOP) fertilizer, on rice yield, harvest index, grain quality and sheath rot incidence.

Treatments
This randomized block trial consisted of twenty plots with three Polysulphate doses (0, 160 and 240 kg/ha) plus two ammonium sulphate doses (129 and 192 kg/ha) applied incorporated at planting and 15 days later. All treatments received a total NPK application of 140, 20 and 60 kg/ha from urea, DAP and KCl. Polysulphate was used as a complementary K source that reduced the KCl application, and a sulphur source to be compared with ammonium sulphate.

Results
- Polysulphate and ammonium sulphate both increased rice yield by 2.5%, but Polysulphate increased harvest index by up to 11%.
- A significant positive effect on grain quality and disease tolerance in rice was observed with Polysulphate applications of up to 240 kg/ha.
- Addition of S from Polysulphate reduced white center in grains by 15 to 19% and diminished Sarocladium incidence by up to 66%.
- The recommendation for the Guayas region is that Polysulphate applied at planting at a rate of 150-200 kg/ha will improve rice productivity and grain quality.





Bars indicate standard errors.

** From research funded by the International Potash Institute www.ipipotash.org.*

Polysulphate

Trial

Rocket salad
Italy

When
Sowing:
October, 2016
Harvest:
October, 2017

Where
Campania, Italy

Crop
Rocket salad *(Eruca sativa)*

Soil type
Silt-loam soil

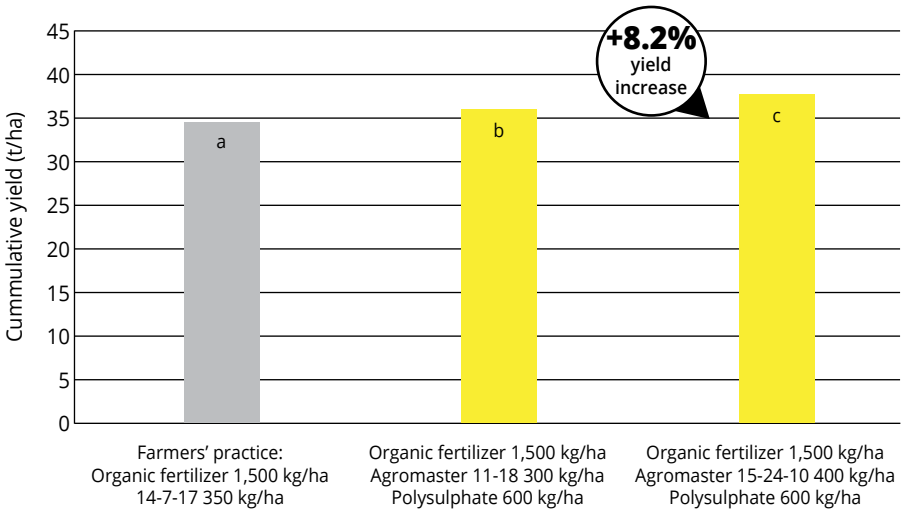
Measurements
- Fresh yield
- Dry matter yield

Different letters within columns indicate statistically significant differences

Objective
To investigate the effect of Polysulphate on the yield of greenhouse grown rocket salad.

Treatments
This trial consisted of three treatments with four replicates in a randomized complete block design. The treatments were: (1) Farmers' practice: 1,500 kg/ha of organic fertilizer + 350 kg/ha of 14-7-17 NPK fertilizer. (2) 1,500 kg/ha of organic fertilizer + 300 kg/ha of Agromaster 11-48 + 600 kg/ha of Polysulphate. (3) 1,500 kg/ha of organic fertilizer + 400 kg/ha of Agromaster 15-24-10 + 600 kg/ha of Polysulphate (Agromaster is ICL's controlled release fertilizer). All fertilizers were applied before sowing. The crop was harvested on 8 successive dates.

Results
- The cumulative yields in the Polysulphate treatments were significantly higher than the farmers' practice (+ 1.58 and + 2.85 t/ha respectively). The differences were evident right from the 1st harvest.
- From the 3rd harvest onwards, the treatments with Polysulphate produced higher dry matter yield per hectare. This parameter is essential to increase the shelf life of the rocket salad after harvesting.
- The return on investment (ROI) was higher in both Polysulphate treatments when compared with the farmers' practice: 1,630 €/ha for the Polysulphate treatment (1) and 3,390 €/ha for Polysulphate treatment (2).



Polysulphate

Trial

Sesame
India

When
Sowing: July 2014
Harvest:
October 2014

Where
Kanpur, Uttar Pradesh, India

Crop
Sesame *(Sesamum indicum L.)*

Soil type
Sandy loam

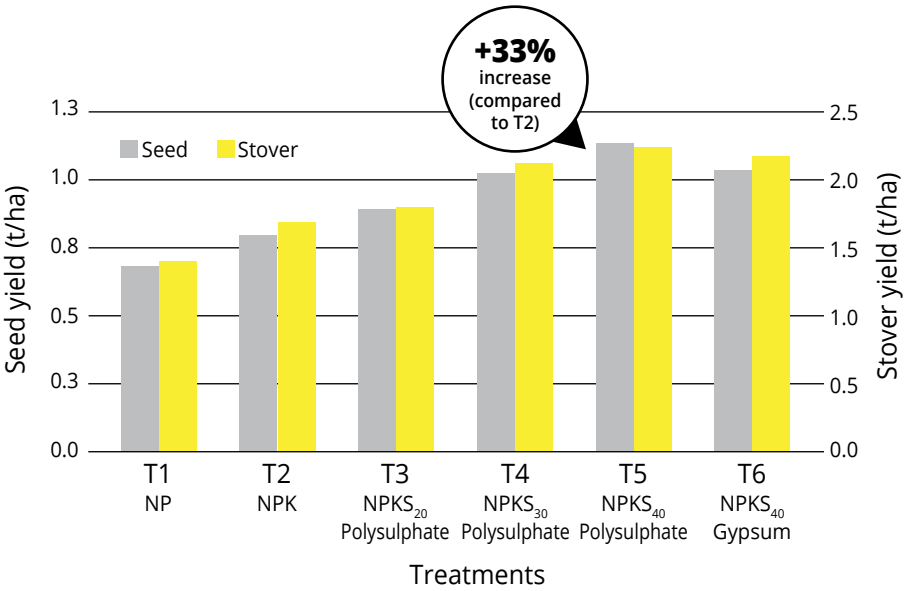
Measurements
- Yield
- Yield components
- Oil content
- Nutrient uptake

Objective
To test the efficacy of Polysulphate as a sulphur source on the performance of sesame crops in India.

Treatments
The experiment was laid out in a randomized block design with three replicates and included six treatments:
- T1: Control without S and K fertilization (100% NP through urea and DAP only)
- T2: 100% NPK (urea, DAP, Muriate of Potash (MOP))
- T3: 100% NP + 50% S through Polysulphate (20 kg S ha^{-1}) (balanced K through MOP to make 100% K)
- T4: 100% NP + 75% S through Polysulphate (30 kg S ha^{-1}) (balanced K through MOP to make 100% K)
- T5: 100% NP + 100% S through Polysulphate (40 kg S ha^{-1}) (balanced K through MOP to make 100% K)
- T6: 100% NPK (urea, DAP, MOP) + 100% S through gypsum (40 kg S ha^{-1})

The recommended dose of fertilizers: 120 kg N, 60 kg P_2O_5, 60 kg K_2O ha^{-1} and 40 kg S ha^{-1} was applied as per the treatments. Full dose of P, K, S and half dose of N were applied at the time of sowing as a basal application. The remaining half dose of N was applied in two equal splits, at the stages of maximum tillering and flower initiation.

Results
- Sesame yield increased significantly and steadily in response to the increasing S dose applied through Polysulphate (T3-T5).
- Seed yield increased by 33% at the maximum S dose of 40 kg S ha^{-1} (T5) when compared to no S addition (T2). The same S dose, when applied through gypsum (T6), yielded slightly fewer seeds.
- The response of oil yield to Polysulphate application was dramatic, providing 43% increase (T5 vs. T2). Sulphur applied through gypsum (T6) also gave rise to a significant increase in oil yields, although to a lesser extent than with Polysulphate.
- Yield components like pods per plant, pod length, seeds per pod and seed weight were highest at the maximum S level (T5).
- K and S uptake by sesame crop increased with increasing S dose applied through Polysulphate (T3-T5).



CD (P=0.05): 0.045 (seed); 0.140 (stover)

From research funded by the International Potash Institute www.ipipotash.org.

Polysulphate

Trial

Soybean
Brazil

When
Sowing: October 2016
Harvest:
February 2017

Where
Lucas do Rio Verde, Mato Grosso state, Brazil

Crop
Soybean *(Glycine max)*

Soil type
Clay soil *(Oxisol)*

Measurements
Yield

All treatments were fertilized with 80 kg/ha of P_2O_5 and 80 kg/ha of K_2O applied as MAP in the furrow, and 80 kg/ha of K_2O applied as KCl in broadcast. Sulphur treatments had a dose of 25 kg S/ha.

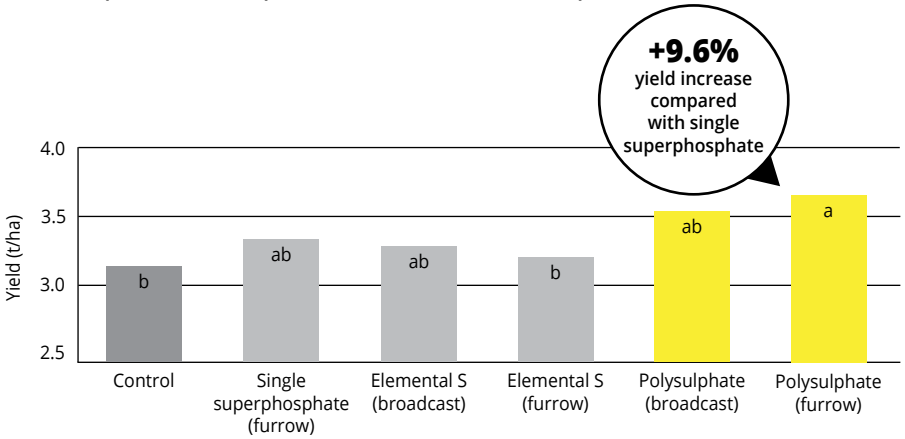
Different letters within columns indicate statistically significant differences

From research funded by the International Potash Institute www.ipipotash.org.

Objective
Evaluate the effect of Polysulphate as a source of sulphur for soybean in Brazil's Cerrado region.

Treatments
This randomized block trial consisted of six treatments and four replications. The treatments were combinations of MAP, KCl, Polysulphate, single superphosphate and pastilled elemental sulphur (S) to supply 80 kg/ha P_2O_5, 80 kg/ha K_2O and 25 kg/ha of S, except in the control treatment where no S was applied. MAP and single superphosphate were applied in furrow; KCl was broadcast before planting; Polysulphate and elemental sulphur were applied both in furrow and broadcast before planting according to each treatment.

Results
- Polysulphate is a highly viable source of sulphur for soybean fertilization.
- Polysulphate fertilizer increased soybean yield by 16% compared with fertilization without sulphur.
- Using Polysulphate as the source of sulphur increased soybean yield by 9.6% compared with single superphosphate.
- A yield improvement of 14% was recorded with Polysulphate compared with pastilled elemental sulphur.



Polysulphate

Trial

Soybean
Argentina

When
2016/17

Where
Mercedes, Corrientes, Argentina

Crop
Soybean *(Glycine max)*

Soil type
Sandy loam soil

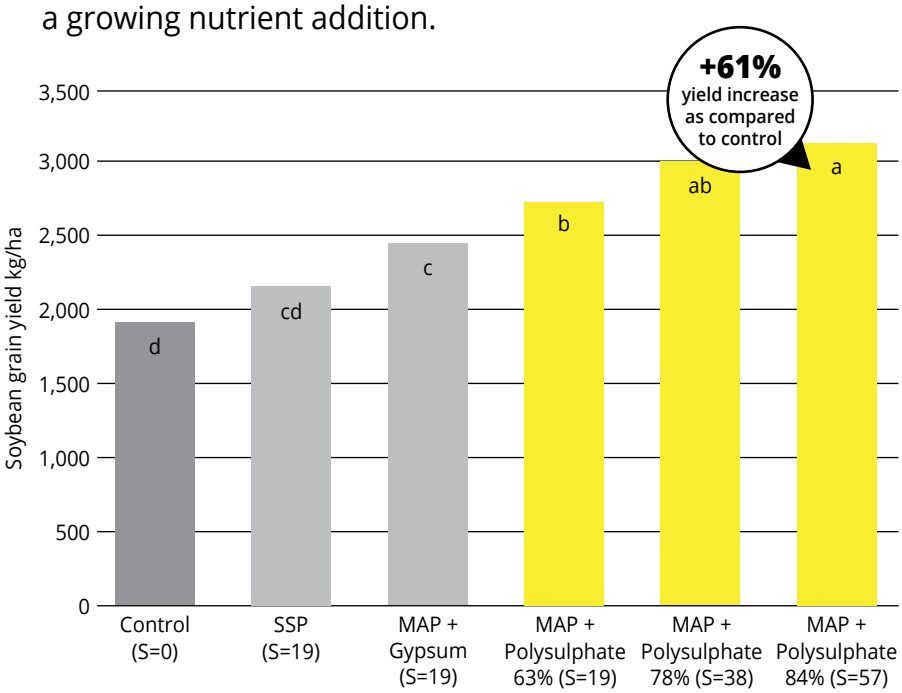
Measurements
Yield

Objective
To compare, under field conditions, the agronomic and economic efficiency of fertilizer bulk blends that include Polysulphate with other current formulations.

Treatments
The treatments were allocated in a randomized complete block design with four replications.

All treatments were based on different sources of S that were applied at sowing and with a single rate of P (30 kg P_2O_5 ha^{-1}), in addition to other fertilizer combinations, including a control with no sulphur. Gypsum and single super phosphate (SSP) treatments were included, since they were the common sources of S with comparable rates of S to Polysulphate.

Results
- Soybean responded significantly to sulphur application
- There were statistical differences between the Polysulphate and other sources of sulphur. Additionally, the soybean responded to increasing rates of Polysulphate as a result of a growing nutrient addition.



Different letters above bars indicate significant differences among treatments ($p<0.05$)

From research funded by the International Potash Institute www.ipipotash.org.

Polysulphate

Trial

Soybean
Brazil

When
Planting:
November 2018
Harvest: March 2019

Where
Cruz Alta, Rio Grande do Sul state, Brazil

Crop
Soybean *(Glycine max)*

Soil type
Clay oxisol

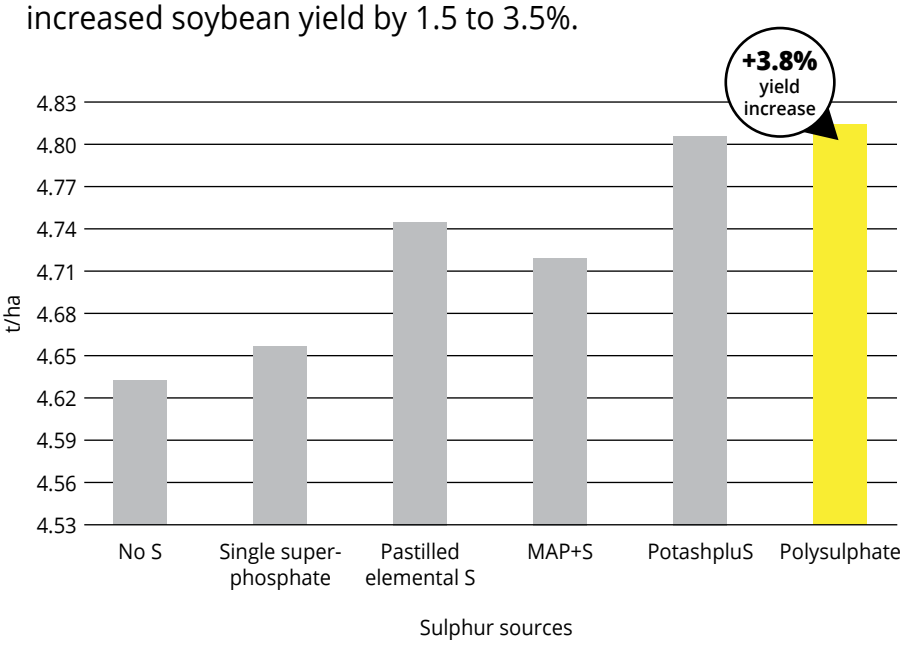
Measurements
Yield

All treatments were fertilized with 80 kg/ha P_2O_5, 80 kg/ha K_2O and 20 kg/ha S, except control treatment where sulphur was not applied.

Objective
To evaluate the agronomic efficiency of Polysulphate and PotashpluS as a sulphur source on the yield of soybean.

Treatments
This randomized block trial consisted of six treatments with four replications. Treatments were combinations of MAP, MOP, Polysulphate, PotashpluS, single superphosphate, pastilled elemental S and one commercial blend with MAP and sulphur in two forms, sulphate and elemental. All treatments were fertilized with 80 kg/ha P_2O_5, 80 kg/ha K_2O and 20 kg/ha S, except the control treatment where S was not applied. The MAP, single superphosphate, MAP+S, Polysulphate and pastilled elemental S were applied in the furrow; MOP and PotashpluS were applied broadcast and pre-planting.

Results
- Polysulphate in the furrow and PotashpluS in broadcast were highly viable sources of sulphur for soybean fertilization.
- Soybean yield increased over 3.9% in comparison to the fertilization without sulphur.
- In comparison with other sulphur sources, ICL products increased soybean yield by 1.5 to 3.5%.



Polysulphate

Trial

Soybean
Paraguay

When
Sowing:
October 2017
Harvest: March 2018

Where
Itapúa, Paraguay

Crop
Soybean *(Glycine max)*

Soil type
Ultisol

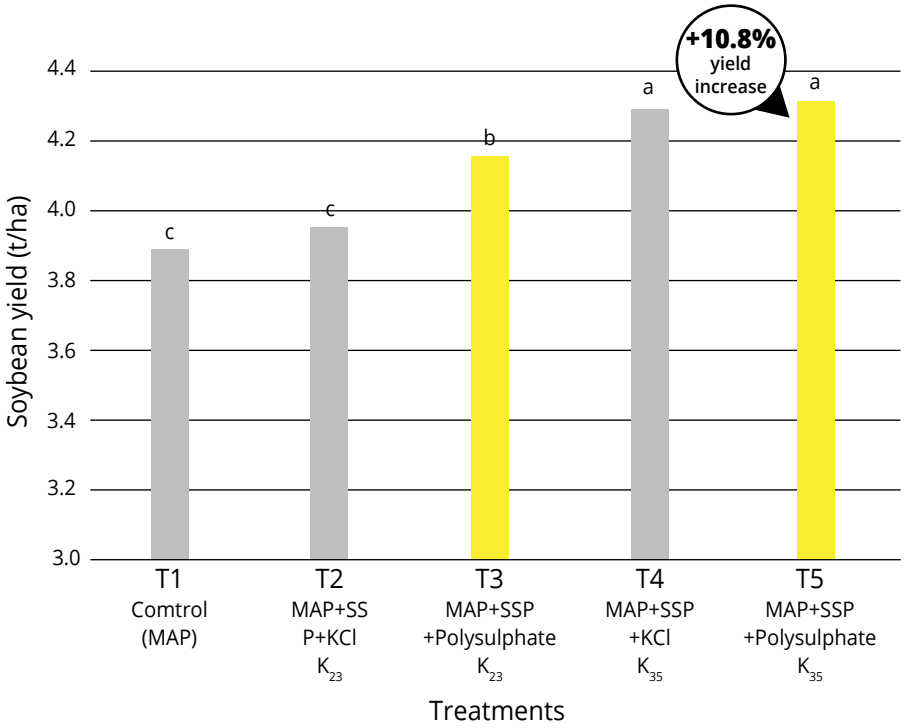
Measurements
Yield

Objective
To compare the agronomic efficiency of bulk fertilizer blends that include Polysulphate with other formulations currently in use, for soybean crop in Paraguay.

Treatments
The five treatments consisted of two common fertilizer blends (5-20-10 and 5-30-15) having different proportions of P_2O_5:K_2O (2:1 and 3:1) and were prepared using MAP, SSP, and a K source (KCl or Polysulphate). The four grades were compared with mono-ammonium-phosphate (MAP) as a control lacking S, K and Mg. All five treatments received the same rate of 70 kg P_2O_5 ha^{-1}.

	Treatment (fertilizer blend)	P_2O_5 : K_2O	Grade NPKS	Fertilizer rate	N	P_2O_5	K_2O	MgO	S
				kg ha^{-1}					
T1	Control - MAP	-	10-52-0-0 S	135	15	70	-	-	-
T2	MAP, SSP, KCl	3:1	5-30-10-5 S	233	11	70	23	-	11
T3	MAP, SSP Polysulphate	3:1	6-30-10-6 S	233	15	70	23	5	15
T4	MAP, SSP, KCl	2:1	5-30-10-5 S	233	12	70	35	-	8
T5	MAP, SSP Polysulphate	2:1	6-30-10-6 S	233	15	70	35	3	10

Results
- Soybean crop showed significant yield increase in response to Polysulphate application at both K_2O doses: 6.8% and 10.8% when compared with the control treatment, for 23 kg K_2O/ha and 35 kg K_2O/ha respectively.
- The use of Polysulphate significantly increased soybean yield by 5.3% (T3: 23 kg K_2O/ha, 3:1 P:K ratio) when compared with KCl as K source (T2); but there was no advantage to either KCl nor to Polysulphate at the higher K_2O dose (2:1 P:K ratio).



Different letters above bars indicate significant differences among treatments (P<0.05)

From research funded by the International Potash Institute www.ipipotash.org.

Polysulphate

Trial

Strawberry
Colombia

When
Planting:
September 2017
Harvest: April 2018 to March 2019

Where
Sotara, Cauca State, Colombia

Crop
Strawberry (*Fragaria X ananassa Duch.*, cv Sabrina)

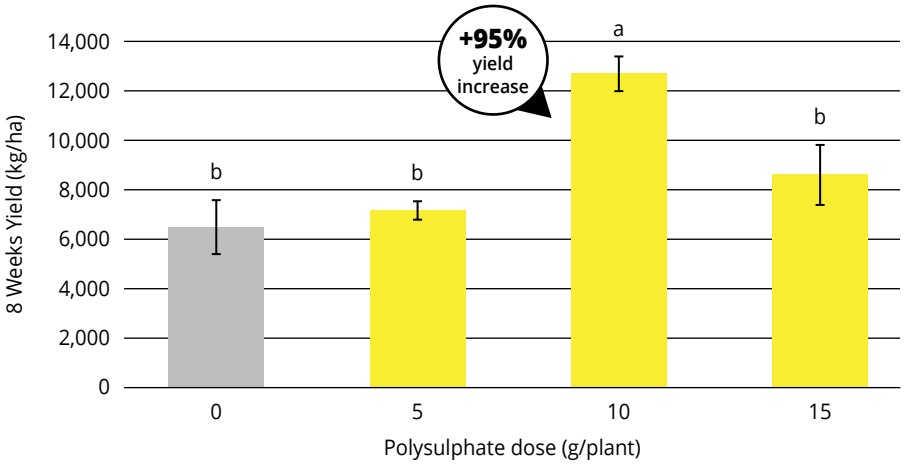
Soil type
Andisol, Silt loam with acidic pH (5.6), high OM (26.3%) and medium K, Ca, Mg contents

Measurements
Total yield during two months of the harvest peak

Objective
To evaluate the effect on strawberry yield of using Polysulphate as a complementary nutrient source.

Treatments
This trial consisted of twelve 35 m beds, each with 210 plants. Four treatments, or Polysulphate doses, were applied on a one year old plantation: 1) No Polysulphate, 2) 5 g/plant (250 kg/ha), 3) 10 g/plant (500 kg/ha), 4) 15 g/plant (750 kg/ha). All treatments received a total NPK application of 200, 140 and 280 kg/ha, from urea, Enraifos, potassium sulphate, kieserite and included Polysulphate as a complementary K, Ca and Mg source. All treatments were also fertigated every week using a farmer's combination of all nutrients.

Results
- Polysulphate had a positive effect on strawberry yield.
- Polysulphate increased yield up to 95% compared with the control without Polysulphate.
- Supply of K, Ca, Mg and S from Polysulphate improved the fruit setting, appearance and shelf life.
- A recommended Polysulphate dose of 10 g/plant twice or three times a year increases strawberry productivity and improves fruit quality.



Bars indicate standard errors. Different letters indicate significant differences among treatments by Tukey test (P=0.05)

Polysulphate

Trial

Strawberry
China

When
Sowing:
6 September 2016
Harvest:
5 December 2016

Where
Wuhan, Hubei province, China

Crop
Strawberry *(Fragaria ananassa)*

Soil type
Calcareous alluvial soil

Measurements
- Fruit weight
- Fruit quality
- Yield

Objective
To evaluate the effect of replacing the K supplied by the farmers practice with Polysulphate on the yield and quality parameters of strawberry crop grown in Hubei Province, China.

Treatments
Farmer practice: 525 kg/ha compound fertilizer (N: P_2O_5: K_2O 12:12:17).

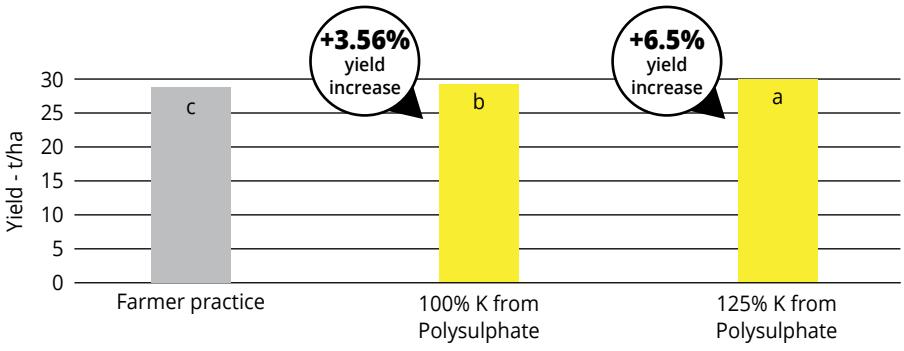
Equal replacement (100% K from Polysulphate): K from Polysulphate used to replace 100% K in compound fertilizer used by farmers. N from urea and P from DAP.

125% K from Polysulphate: 125% K from Polysulphate was used. N from urea and P from DAP.

All treatments received 375 kg/ha of calcium superphosphate at seedling; 500 kg/ha of organic fertilizer in top-dressing, three to five times; 75 kg/ha of American Jiabao (22% K_2O) + 75 kg/ha Ultrasol (15% K_2O) during fruit period.

Results

	Total acidity	Soluble solid (%)	Sugar-acid ratio	Flavor	Average weight per fruit (g)	Average weight per plant
Farmer practice	3.26 b	6.17 c	1.89 b	Sweet and sour	29.12 b	56 c
100% K from Polysulphate	3.42 a	6.57 b	1.92 b	Sweet and sour	31.02 b	60 b
125% K from Polysulphate	3.44 a	7.17 a	2.08 a	Sweet	35.22 a	63 a



Conclusions
When adding the same amount of K through Polysulphate compared with compound fertilizer, there is a significant increase in the total acidity, fruit soluble solids, flavor, average weight per fruit, number of fruit per plant and yield. This trend strengthens when adding an additional 25% of K through Polysulphate.

Different letters within columns indicate statistically significant differences

Research Partner
Wuhan Academy of Agriculture Science, Huangpi district, cooperation with AMPC Zhejiang.

Polysulphate

Trial

Sugarcane
USA

When
Planting:
Second ratoon
Harvest:
October, 2018

Where
USDA ARS Sugarcane Research Unit
White Castle,
Louisiana, USA

Crop
Sugarcane
(Saccharum officinarum)

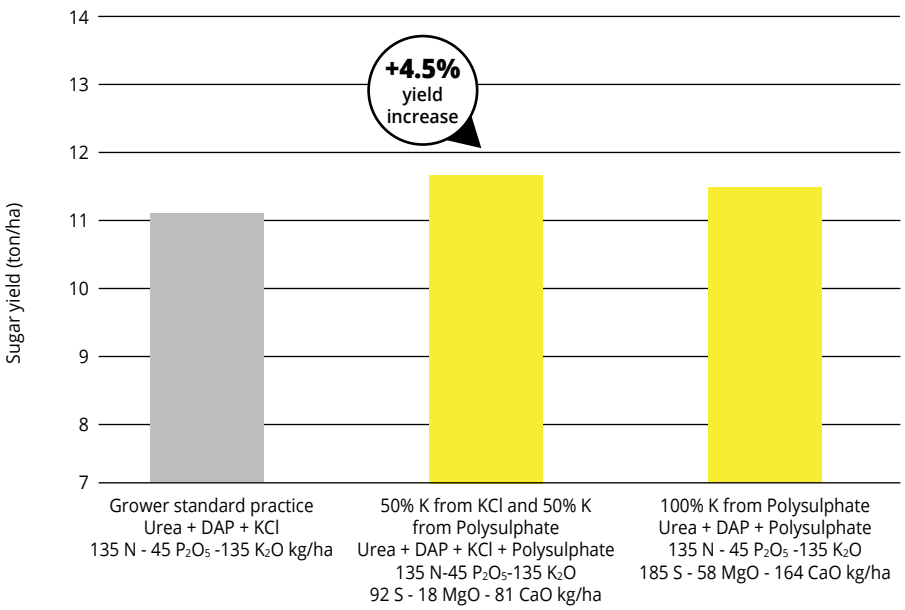
Soil type
Sandy, silt-loam soil

Measurements
Sugar yield

Objective
To evaluate Polysulphate as a K fertilizer source for sugarcane grown in sandy, silt-loam soils in southern Louisiana, USA.

Treatments
Grower standard practice consisted of 135 kg N/ha in the form of urea, 45 kg P_2O_5/ha in the form of DAP and 135 kg K_2O/ha in the form of KCl. There were two Polysulphate treatments which were duplicates of the grower standard practice , but with the K portion being made up of 50:50 Polysulphate & KCl, or 100% Polysulphate.

Results
- Supplying 50% of the K dose as Polysulphate increased the sugarcane yield by 504 kg/ha (4.5%) over conventional grower standard practice.



Polysulphate

Trial

Sugarcane
Colombia

When
Planting:
September 2018
Harvest: January 2019

Where
Balboa, Risaralda State, Colombia

Crop
Sugarcane (*Saccharum officinarum*), var. CC01-1940 at seedling stage

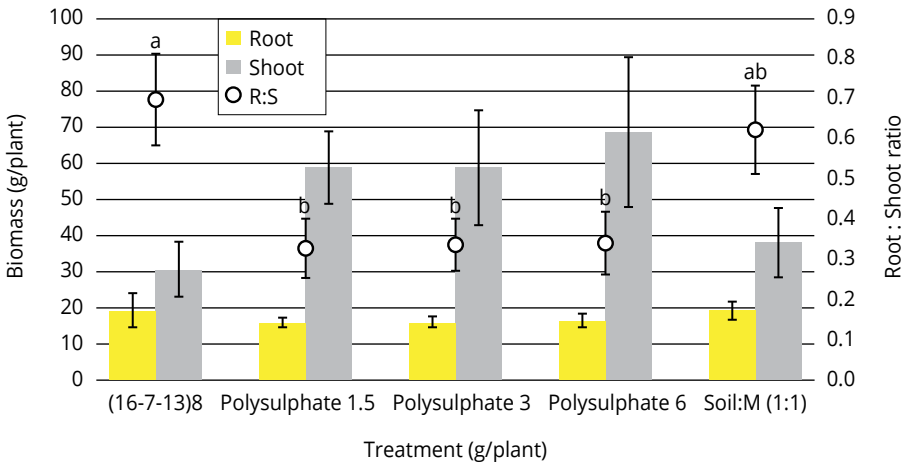
Soil type
Vertisol, sandy loam with acidic pH (6.2); low OM (2.5 %); and high Ca and Mg content

Measurements
- Shoot and root biomass
- Root: shoot ratio

Objective
To evaluate the effect on sugarcane of using Polysulphate as a complementary nutrient source, in particular its effect on biomass at the seedling stage.

Treatments
This trial consisted of five treatments: two controls and three Polysulphate doses (0, 1.5, 3 and 6 g/plant) applied 5 days after planting. 1) 8 g of 16-7-13, 2) 1.5 g of Polysulphate, 3) 3 g of Polysulphate, 4) 6 g of Polysulphate, 5) A mixture of soil and compost (1:1). Treatments 1-4 received a total NPK application of 1.3, 0.6 and 1.1 g/plant from urea, DAP and using Polysulphate as a complementary K source reducing the KCl applied.

Results
- Polysulphate had a positive effect on sugarcane seedling growth at all application rates up to 6 g/plant.
- Polysulphate significantly increased shoot biomass, doubling it, when compared with the two controls without Polysulphate.
- Supply of K, Ca, Mg and S from Polysulphate reduced root biomass.
- Plants fertilized with Polysulphate had a root:shoot ratio half that of the controls, indicating better biomass partitioning in sugarcane seedlings.
- A recommended dose of 200-300 kg/ha of Polysulphate for the Cauca river valley would improve shoot biomass and sugarcane productivity.



Bars indicate standard errors. Different letters indicate significant differences among treatments by Tukey test (P=0.05)

Polysulphate

Trial

Tea
Vietnam

When
Sowing: 8 May 2016
Harvest: 3 July 2016

Where
Lam Dong district, Vietnam

Crop
Tea (*Camillia sinensis*)

Soil type
Fluvo-aquic soil

Measurements
- Bud density
- Bud weight
- Bud length
- Tea bud yield
- Tea quality parameters

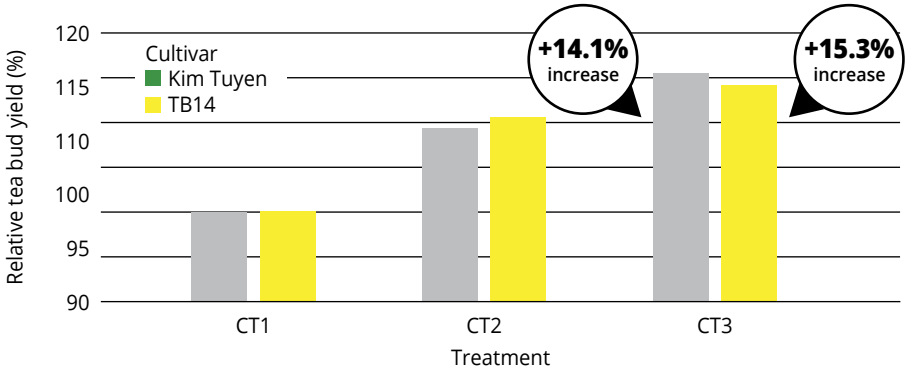
Research Partner
Petrovietnam Fertilizer and Chemicals Corporation (PVFCCo), Vietnam.

Objective
Polysulphate was examined as a potential additive to compound NPK fertilizers, as part of an alternative fertilization program for the tea industry in the Lam Dong district.

Treatments
Three fertilizer treatments were tested at two sites of seven year old tea plantations of two varieties of tea (Kim Tuyen and TB14) between April and December 2015. The first treatment (CT1) was farmers' standard fertilizer practice, the second treatment (CT2) used locally available commercial compound fertilizer and the third treatment (CT3) was the same as CT2 but fortified with Polysulphate.

Fertilizer	Bao Loc (cv. Kim Tuyén)			Bao Lam (cv. TB14)		
	CT1 (Control)	CT2 (Phu My Fertilizer)	CT3 (Phu My Fertilizer + Polysulphate)	CT1 (Control)	CT2 (Phu My Fertilizer)	CT3 (Phu My Fertilizer + Polysulphate)
	Amount of fertilizer (kg ha^{-1})					
Polysulphate	0	0	200	0	0	150
NPKS (16-16-8-13)	0	800	800	0	400	400
NPK (15-15-15)	0	1,000	1,000	0	500	500
NPK (25-9-9)	0	1,500	1,500	0	750	750
NPK (27-6-6)	0	1,500	1,500	0	750	750
Urea	3,200	900	900	1,600	450	450
Fused Ca-Mg-P	3,353	0	0	1,677	0	0
KCl	832	100	53	466	100	65

Results
Polysulphate, added to a systematic NPK fertilization program for tea plants grown on reddish brown soil in Lam Dong, Vietnam, enhanced the density, weight and size of tea buds, thus increasing tea productivity of both varieties of tea by 14.1-15.3%. Polysulphate also improved tea quality parameters such as dry matter content and the concentrations of soluble substances, tannins and caffeine, which are important for flavor in tea.



Conclusions
Polysulphate enhances the volume and quality of tea buds. Overall, Polysulphate increased farmers' profit by up to 13%. For both cultivars, CT2 was significantly more profitable than CT1, and CT3 more than CT2. These results suggest that the common tea fertilization practice (CT1) in these regions of Vietnam may be considerably improved by using Polysuphate.

Polysulphate

Trial

Tomato
China

When
Planting: April 2016
Harvest: July 2016

Where
Zhoukou, Henan province, China

Crop
Tomato *(Solanum lycopersicum)*, variety NO.4 Zhengfen

Soil type
Fluvisol
(fluvo-aquic soil)

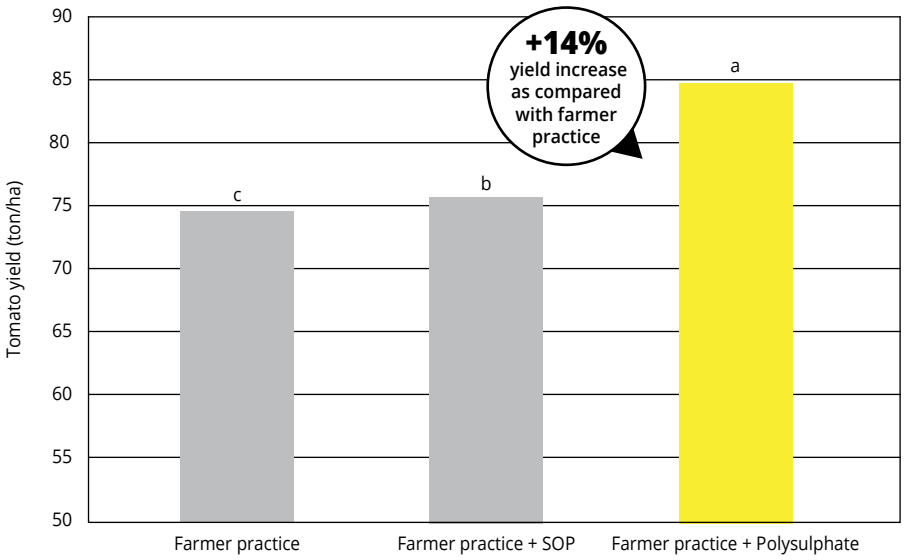
Measurements
- Yield
- Number of fruits per plant
- Fruit weight

Objective
To evaluate the addition of Polysulphate and sulphate of potash (SOP) to the farmers' practice on the yield and yield parameters of tomato crop grown in Henan Province, China.

Treatments
This randomized complete block trial consisted of three replicates with three treatments. 1) Farmer practice, 2) Farmer practice + 750 kg/ha of SOP, and 3) Farmer practice + 750 kg/ha of Polysulphate.

Farmer practice consisted of applying 7.5 ton/ha organic fertilizer as base-fertilizer. In addition, there were 4 topdressings of 240 kg/ha of urea during the whole growth period.

Results
- Polysulphate application led to an increase in the number of fruits per plant, and an increase in fruit weight.
- Compared with SOP application, the average yield in the treatment with Polysulphate increased by 8.84 ton/ha (yield increase of 11.6%).
- Polysulphate application significantly increased yields as compared with farmer practice: the average yield when treated with Polysulphate increased by 14%.



Different letters above bars indicate significant differences among treatments (P <0.05)

Polysulphate

Trial

Tomato
China

When
Planting: March 2016
Harvest: June 2016

Where
Shangqiu, Henan province, China

Crop
Tomato *(Solanum lycopersicum)*, variety NO.4 Zhengfen

Soil type
Sandy, fluvisol (fluvo-aquic soil)

Measurements
- Yield
- Number of fruits per plant
- Fruit weight

Objective
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Treatments
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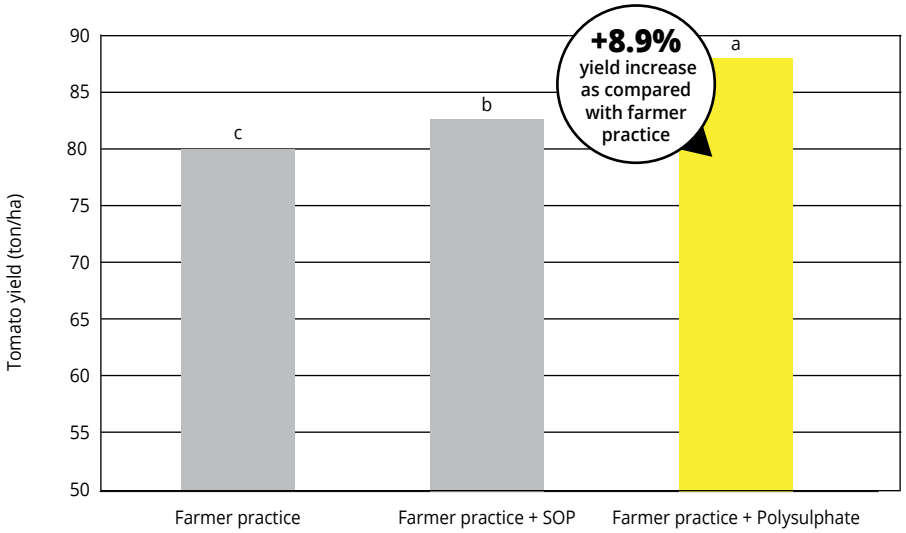
Farmer practice consisted of applying 7.5 ton/ha organic fertilizer as base-fertilizer. In addition, there were 4 topdressings during the whole growth period. Each topdressing consisted of 75 kg/ha urea and 150 kg/ha compound fertilizer (15-15-15).

Results
- Polysulphate application led to an increase in the number of fruits per plant, and an increase in fruit weight.
- Compared with SOP application, the average yield in the treatment with Polysulphate increased by 4.88 ton /ha (yield increase of 5.9%).
- Polysulphate addition significantly increased yields as compared with farmer practice: the average yield when treated with Polysulphate increased by 8.8%.



Different letters above bars indicate significant differences among treatments (P <0.05)

Polysulphate

Trial

Tomato
Colombia

When
Planting:
August 2018
Harvest:
November 2018

Where
Popayán, Cauca State, Colombia

Crop
Tomato (*Solanum lycopersicum*) hybrid *Ichiban*

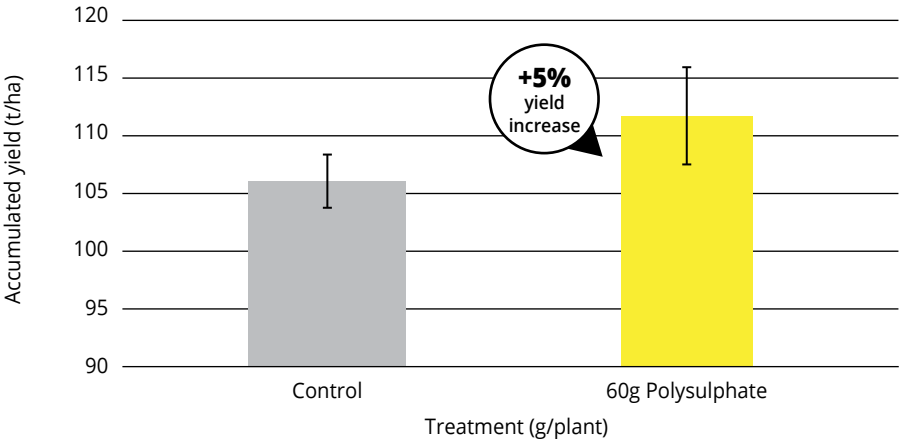
Soil type
Andisol, silt loam with acidic pH (5.3), high OM (15.9%) and medium K, Ca, and Mg content

Measurements
Total yield

Objective
To evaluate the effect on tomato yield of using Polysulphate as a complementary nutrient source.

Treatments
This trial consisted of six rows with two treatments: 1) No Polysulphate, 2) 60 g of Polysulphate/plant, equivalent to 1.5 tons/ha, applied 46 days after planting. Both treatments received a total NPK application of 200, 200 and 400 kg/ha, from 10-30-10, 10-20-20, 16-16-16. Treatment 2 used Polysulphate as a complementary K source that reduced the KCl application. The whole crop received soil fertilization at 10, 46, 55 and 85 days after planting, plus fertigation every two weeks.

Results
- Polysulphate increased tomato yield by 5% compared with the control.
- Addition of K, Ca, Mg and S from Polysulphate improved the fruit setting and appearance.
- Polysulphate application resulted in a high reduction of blossom-end rot, common in the region.
- A dose of 30-60 g/plant of Polysulphate is recommended to increase tomato productivity and improve fruit quality.



Bars indicate standard errors.

Polysulphate

Trial

Winter wheat
UK

When
2018

Where
UK

Crop
Winter wheat
(Triticum aestivum)

Soil type
Sandy clay loam

Measurements
Yield

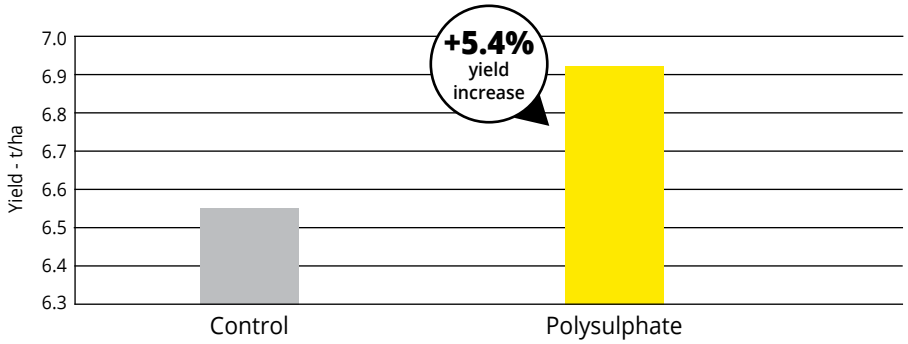
Objective
To investigate the effect of Polysulphate fertiliser as an autumn application to winter wheat. Specifically, to increase yield through crop establishment.

With UK soils being low or critical for sulphur deposits and plants needing S to take up nitrogen, this experiment is designed to test whether Polysulphate improves residual nitrogen uptake by the plant and improves establishment of the crop.

Treatments
The base fertiliser (0-20-30) was applied at 250 kg/ha. The field was split down the middle.

250 kg/ha 0-20-30 base fertiliser 100 kg/ha Polysulphate	250 kg/ha 0-20-30 base fertiliser
Field A - 1.92 ha	*Field B - 1.92 ha*

Results
Below you can see the difference in yield between the control and the area treated with Polysulphate, a yield improvement of 354 kg/ha.



Conclusion
In this trial we found that Polysulphate improved the overall yield by 354 kg/ha. The average price for grain was £170/t (according to the farmer), which means that Polysulphate fertiliser improved the return for the farm by £60.18 per ha.

When we remove the costs of the 100 kg of fertiliser (£16) per hectare, the return on investment in this trial is £44.18/ha.

Polysulphate

Trial

Wheat
Argentina

When
2016

Where
Nueve de Julio, Argentina

Crop
Wheat
(Triticum aestivum)

Soil type
Sandy loam soil

Measurements
- Grain yield
- Protein yield

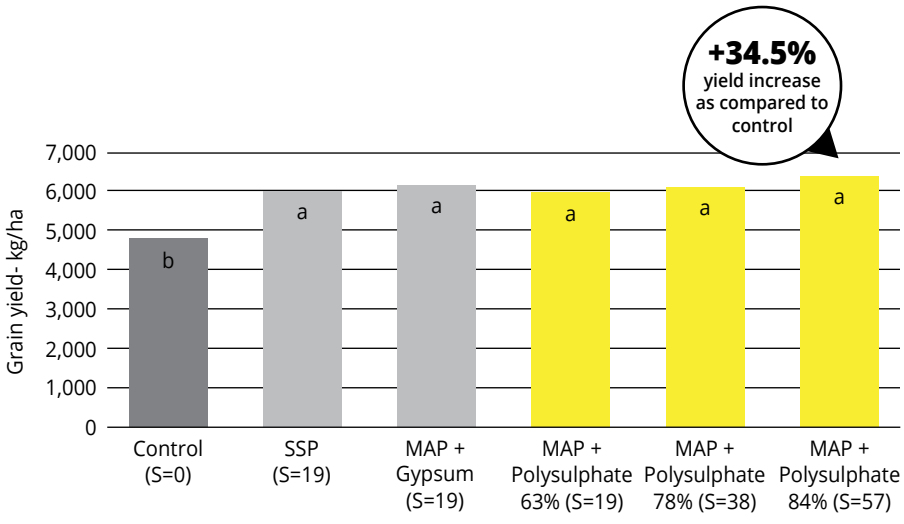
Objective
To compare, under field conditions, the agronomic and economic efficiency of fertilizer bulk blends that include Polysulphate with other current formulations.

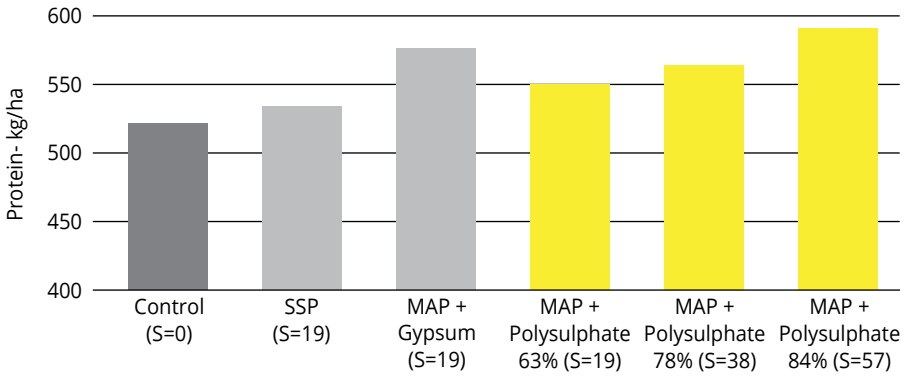
Treatments
The treatments were allocated in a randomized complete block design with four replications.

All treatments were based on different sources of S that were applied at sowing and with a single rate of P (30 kg P_2O_5 ha^{-1}), in addition to other fertilizer combinations, including a control with no sulphur. Gypsum and single super phosphate (SSP) treatments were included, since they were the common sources of S with comparable rates of S to Polysulphate.

The crop received 75 kg N ha^{-1}, applied prior to emergence in the form of urea.

Results
- The response to sulphur was conclusive, giving the statistical difference between the check and the other treatments.
- Quality parameters like protein and gluten content also responded to S.
- Although not statistically significant, a positive response to growing rates of Polysulphate were noted.





Different letters above bars indicate significant differences among treatments ($p<0.001$)

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