

we are where it really matters



Thiosulphate soil chemistry in Mango production

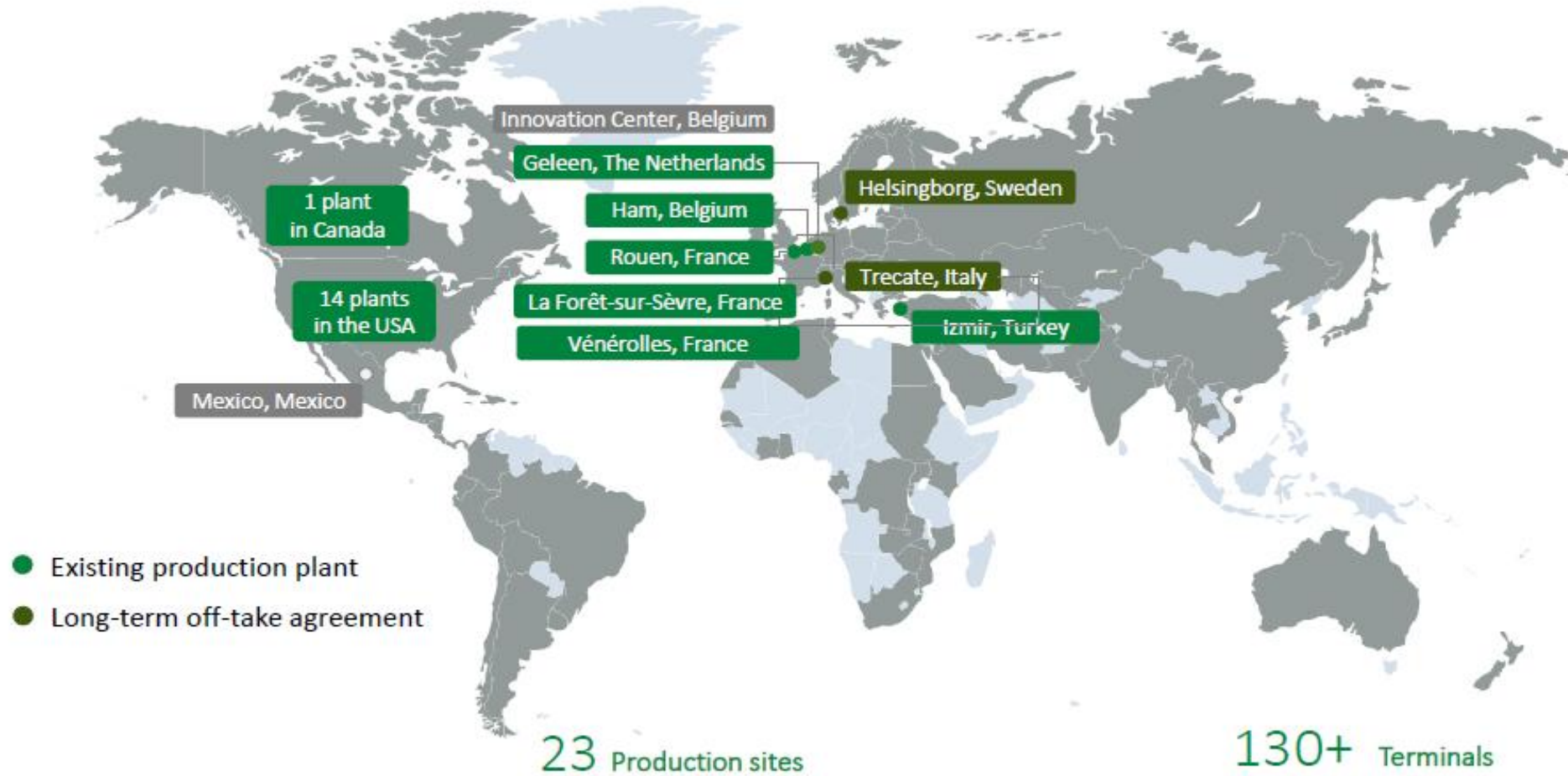
Thiosulfates in mango production

- Background of production and use
- Difference between Sulphate and Thiosulphate
- Effect on Phosphate in soil
- Effect on micronutrient uptake
- Effect on nitrification and N efficiency
- Composition of the 3 products in Thiosulphate range
- Properties (EC)



Background : Tessenderlo Kerley

TESSENDERLO KERLEY (TK INTERNATIONAL & TK INC.) PRESENCE



TK International
+ 500 employees

8 production sites
across Europe

Recurring sales
in over 90 countries

Serving yearly about
800 customers

Local sales and
agronomy presence
in ~ 25 countries



Background : Production facility Ham, Belgium



Background : Production facility Ham, Belgium



Background : Production facility Geleen, Netherlands



THIOSULPHATES ARE SAFE FERTILIZERS

➤ Thiosulphates have neutral pH

Wide compatibility with agrochemicals - with the exception of the acid ones

➤ Thiosulphates are safe and easy to handle

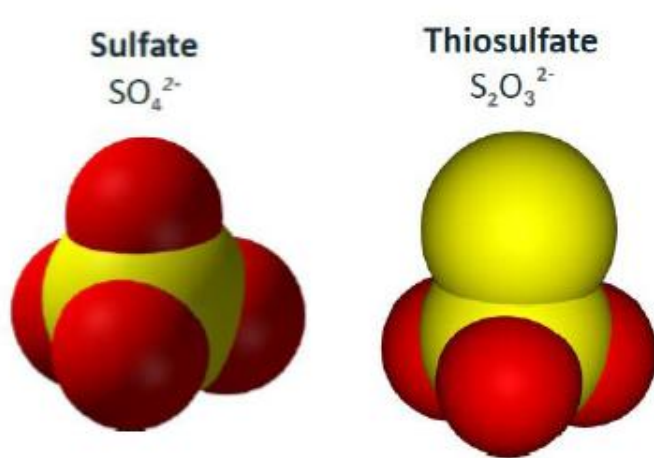
No HAZCHEM restrictions

➤ Thiosulphates can be stored in most common tanks and containers

Except those made from aluminum or galvanized steel



Thiosulphate structure and properties



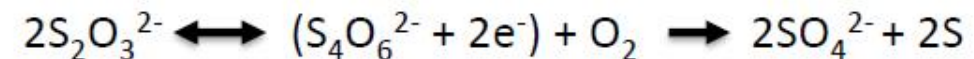
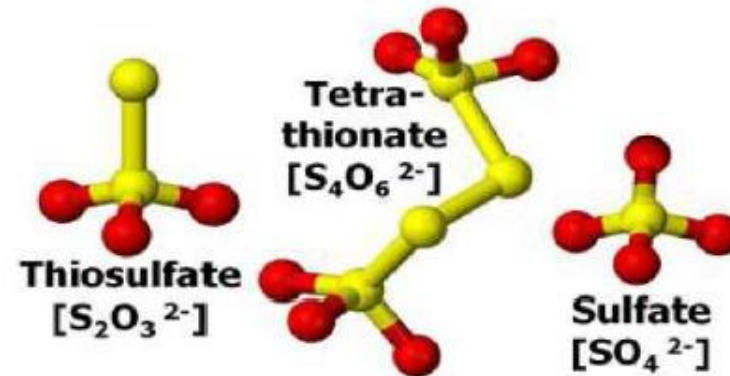
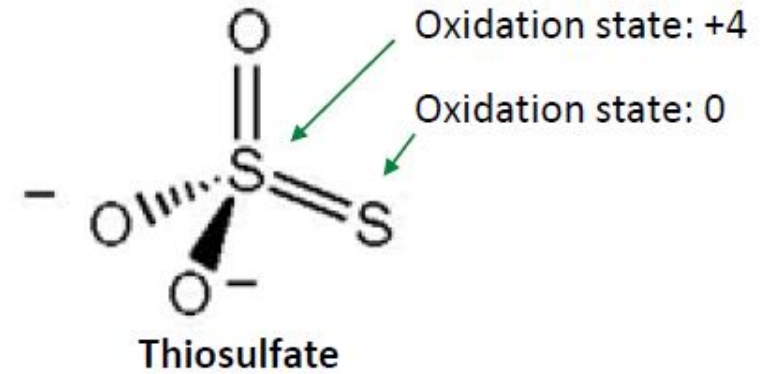
Thiosulfate ($\text{S}_2\text{O}_3^{2-}$) - Oxyanion of sulphur
Thio is the name for sulfur in Greek

Sulfuric Acid H_2SO_4

Sulfate SO_4^{2-}

Thiosulfuric Acid $\text{H}_2\text{S}_2\text{O}_3$

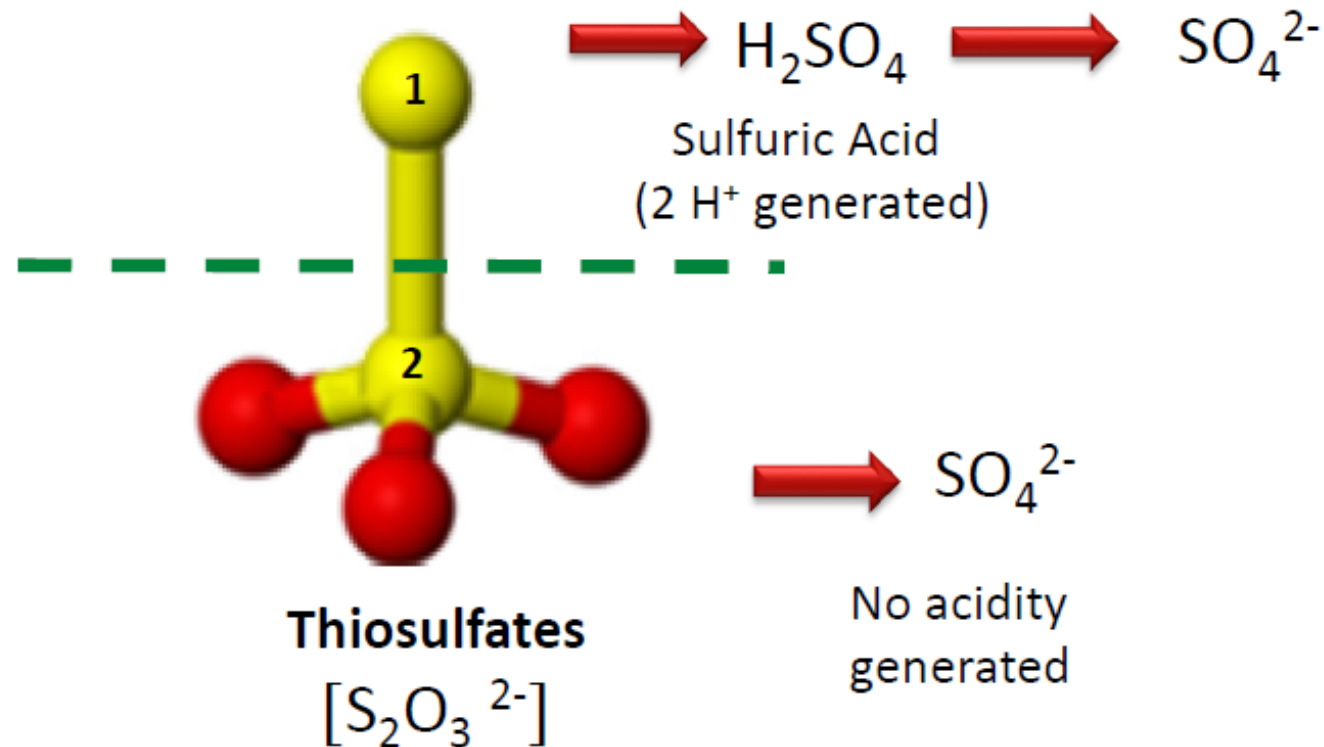
Thiosulfate $\text{S}_2\text{O}_3^{2-}$



- Thiosulfates can be found naturally and are produced by certain biochemical processes
- *Thiobacillus sp.* can metabolize thiosulfates

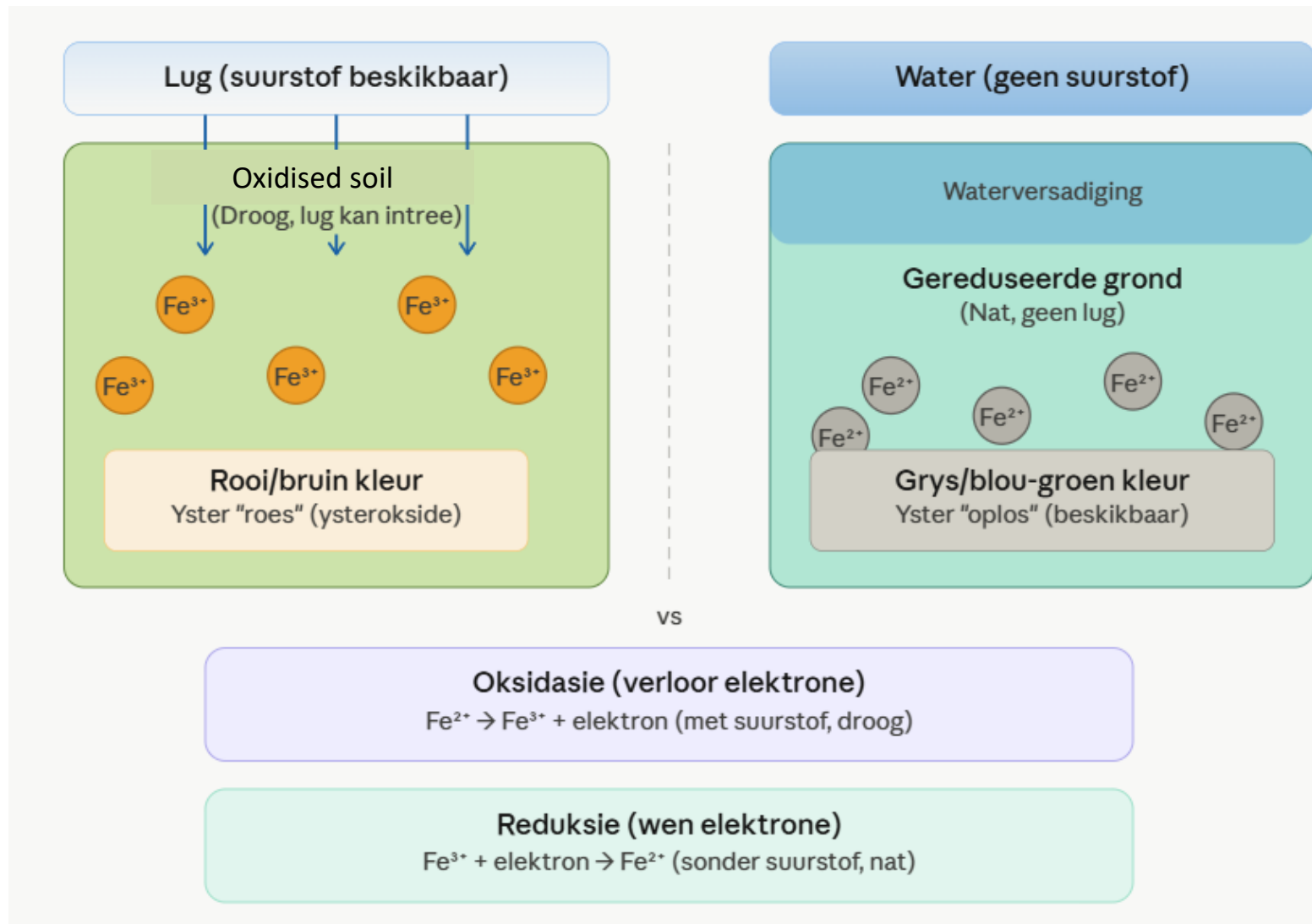
Thiosulphate reaction in soil

- In the thiosulfate ion, One of the S atoms (1) is a sulfide-like atom that gives the thiosulfate its reducing properties and complexing abilities
- The other S atom (2) behaves like a sulfate



Oxidation and Reduction in soil

In a well aerated soil where oxygen is present, **oxidation** will occur naturally.



Thiosulphate reaction in soil: Micronutrient solubilisation

NUTRIENTS SOLUBILIZATION

Nutrients foliar content in a comparative trials in Citrus

Thesis	Fe	Mn	Cu	Zn
NOP	69.04 NS	55.33 NS	11.34 NS	57.00 NS
SOP	68.40 NS	51.63 NS	12.63 NS	52.50 NS
KTS	79.11 *	66.23 *	12.66 NS	79.14 *



Thiosulphate reaction in soil: Micronutrient solubilisation

NUTRIENTS SOLUBILIZATION

Nutrients foliar content in a comparative trials in Clemenules
Mandarines



Thesis	Fe		Mn		Zn		Cu	
	Control	ThioSul®	Control	ThioSul®	Control	ThioSul®	Control	ThioSul®
Year 1	83.95	89.32	27.67	53.43**	41.96	102.16**	5.42	6.83*
Year 2	86.15	94.21*	39.14	65.39**	62.36	123.18**	6.1	7.41*

1. Zn – activates Tryptophan (Trp) synthase enzyme – Trp precursor for auxin

Auxin regulates the expansion and division of cells.

Without auxin:

- cells divide slowly
- cells remain smaller
- shoots elongate poorly
- roots develop slowly
- flowers abort more easily
- young fruit may drop prematurely

Phosphate fixation on Fe oxide and hydroxide

In well aerated soil with sufficient oxygen, Iron will be oxidized



- Fe^{2+} = reduced Iron (more soluble)
- Fe^{3+} = Oxidized Iron (less soluble)

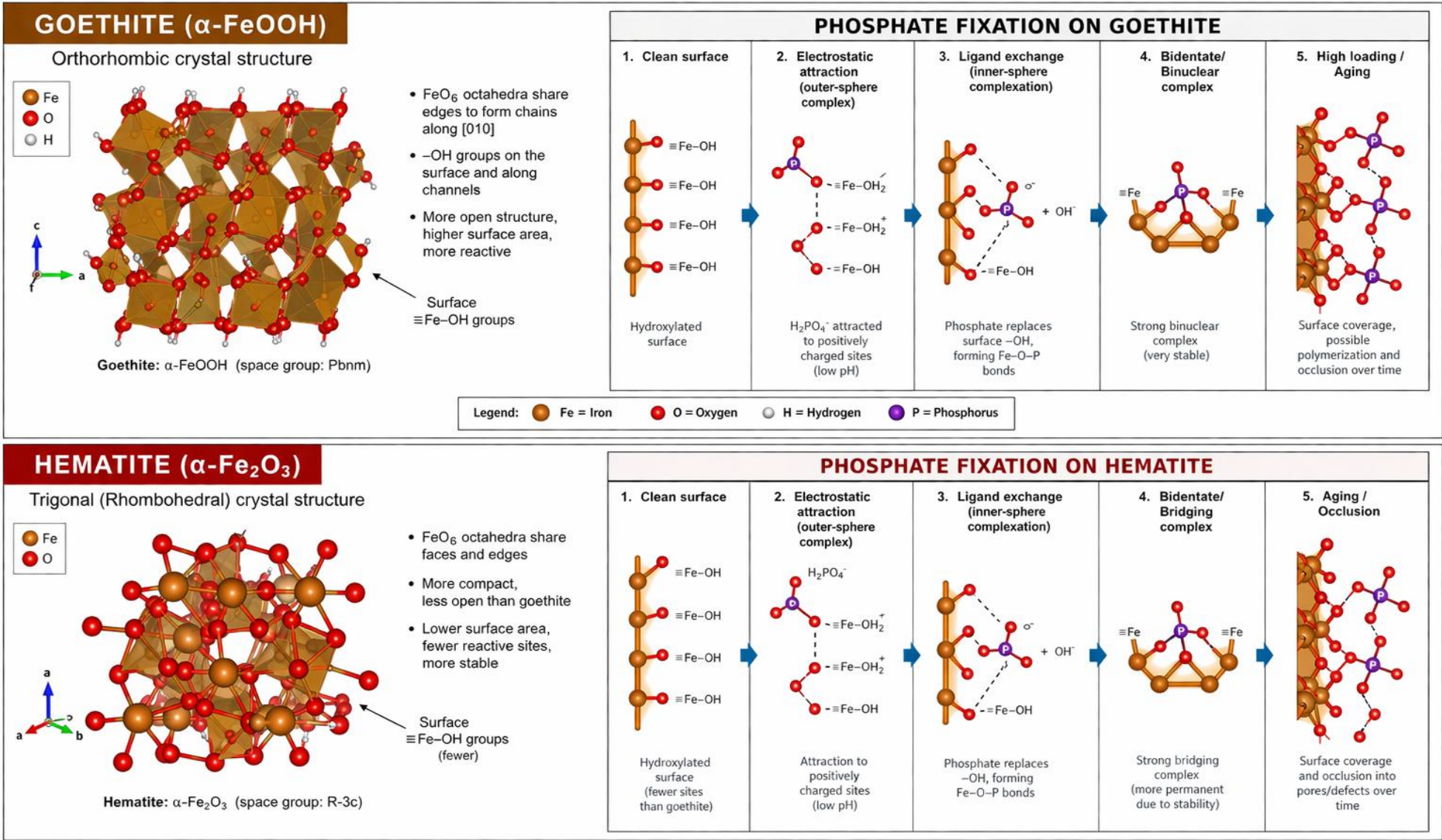
Fe^{3+} reacts with water to form Iron hydroxide



- Ferrihydrite
- Goethite
- Hematite

These Iron oxides have enormous surface area – hydroxide ion (OH^-) replaced by Phosphate ($H_2PO_4^-$)

Thiosulphate reaction in soil: Release of fixed phosphate on Iron oxides



KEY DIFFERENCES:

- | | | | |
|--------------------|---|---|---|
| • Goethite: | More open structure, more $-\text{OH}$ groups, higher surface area | → | Higher phosphate adsorption capacity, faster uptake |
| • Hematite: | More compact structure, fewer $-\text{OH}$ groups, lower surface area | → | Lower capacity, slower uptake, but more permanent once fixed |

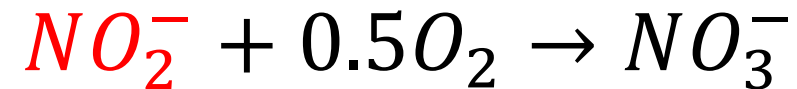
Step 1: Ammonium → Nitrite

Nitrosomonas



Step 2: Nitrite → Nitrate

Nitrobacter



👉 Result:

- Nitrate (NO_3^-) is **mobile** → subject to leaching
- Enzyme: **Ammonia monooxygenase (AMO)**

Step 1: Temporary depletion of oxygen

Nitrosomonas

All available oxygen utilized by Thiobacillus for oxidation of S to SO_4^{2-}

Step 2: Toxic intermediates (polythionates, Sulfite, S)

Disrupt enzymes involved in oxidation of ammonium (AMO)

Step 3: Mikrobial competition

Thiobacillus outcompetes Nitrosomonas and Nitrobacter for available resources

Step 4: Localised decrease in pH

Suppress nitrification enzyme activity

NB!! This is a temporary effect unlike chemical Nitrification inhibitors – effect last for 14 – 21 days.

Ammonium Thiosulphate registered as Nitrification inhibitor

DocuSign Envelope ID: ASF3F20C-B822-436C-810A-78DD540594F5



Informations générales	
Nom du produit	THIO-SUL
Type de produit	Produit de référence
Catégorie du produit	Produit simple
Titulaire	TESSENDERLO GROUP Rue du Trône, 130 BRUXELLES Belgique
Classe - Type	Matière fertilisante - Solution de thiosulfate d'ammonium Additif agronomique au sens de la norme NF U44-204 pour un usage en mélange à des engrais azotés liquides conformes aux normes NF U42-001-1, NF U42-001-2, NF U42-001-3 ou au règlement (UE) 2019/1009 - Solution de thiosulfate d'ammonium.
Etat physique	Solution
Numéro d'intrant	9885-2015.01
Numéro d'AMM	1171327

L'échéance de validité de la présente décision correspond à celle de l'autorisation du produit.

La présente décision peut être retirée ou modifiée si des éléments le justifient. Les modalités d'autorisation du produit restent inchangées à l'exception de la modification des conditions mentionnées en annexe de la présente décision.

A Maisons-Alfort, le 17/03/2026

DocuSigned by

AE2816955A42454
Directrice générale déléguée
en charge du pôle produits réglementés
Agence nationale de sécurité sanitaire de
l'alimentation, de l'environnement et du travail (ANSES)

ANNEX: Modification of the Authorization Conditions for the Fertilizing Substance

New Claims Retained

Use as an **agronomic additive** within the framework of standard NF U44-204:

- In mixture with liquid nitrogen fertilizers compliant with standards NF U42-001-1, NF U42-001-2, NF U42-001-3 or Regulation (EU) 2019/1009: **inhibition of nitrogen volatilization.**
- In mixture with liquid nitrogen fertilizers compliant with standards NF U42-001-1, NF U42-001-2, NF U42-001-3 or Regulation (EU) 2019/1009: **inhibition of nitrogen nitrification.**

3 Different Products in the Thiosulphate range

CATS®: HARVEST THE VALUE



A **clear liquid calcium thiosulphate solution** – contains no nitrogen or chlorides -
soil or foliar applied.

SPECIFICATION:	w/w	w/v
Ca	6 %	7.5%
S	10 %	12.5%
TYPICAL PROPERTIES:		
pH range		6.5 – 8.8
Density (at 25°C)		1.25 kg/L



- SOIL AMENDMENT / GYPSUM REPLACEMENT



	CALCIUM (%)	SOLUBILITY (%)	KG SOLUBLE CALCIUM
Gypsum	23	0.2	0.46/MT
CaTs	7.5 (w/v)	100	75/1000L

2.5T/ha Gypsum = 1.15kg immediately available calcium

100L/ha CaTs = 7.5kg immediately available calcium

+ calcium from chemical reaction in the soil

3 Different Products in the Thiosulphate range

KTS[®]: CLEARLY THE BEST CHOICE



Chloride-free **clear liquid potassium thiosulphate** - soil or foliar applied.

SPECIFICATION:	w/w	w/v
K	20.75 %	30.5%
S	17 %	25%

TYPICAL PROPERTIES:	
pH range	6.8 – 8.5
Density (at 25°C)	1.47 kg/L



3 Different Products in the Thiosulphate range

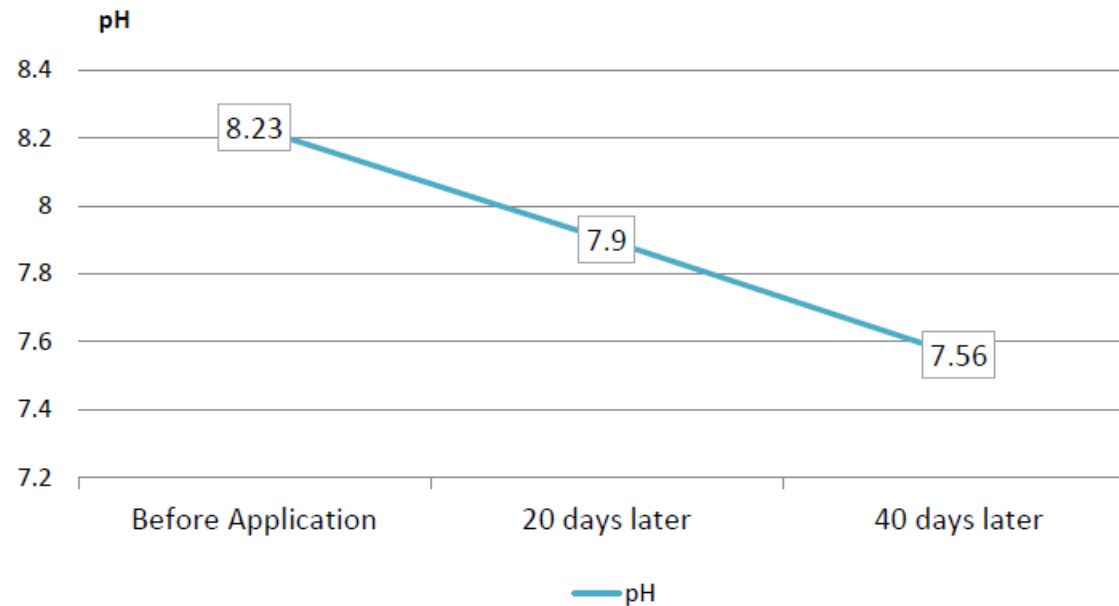
TYPICAL PROPERTIES

	Thio-Sul
- N (w/w)	12%
- S (w/w)	26%
- Appearance/colour	Clear, colourless to light yellow
- pH range	6.5 - 8.5
- Density range (at 25°C)	1.32 kg/l - 1.35 kg/l
- Density (at 25°C)	1.33 kg/l
- Salt Out Temperature (SOT)	+ 7°C
- N (g/l)	160
- S (g/l)	346
- Chemical formula	$(\text{NH}_4)_2\text{S}_2\text{O}_3$



THIO-SUL®: PH-EFFECTS

Trial on orange, Egypt 1995



Thio-Sul supplies of 74 l/ha with fertigation
2 applies (2 x 37 l/ha) with 14 days gap between apply

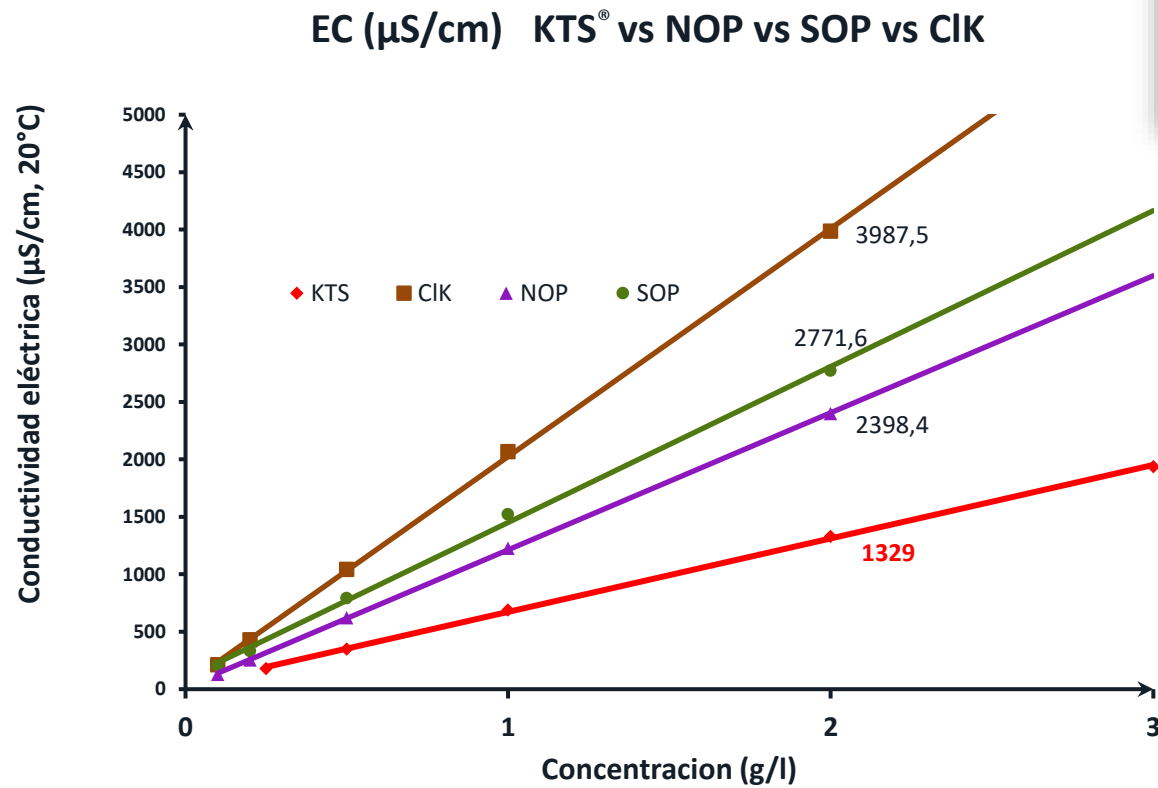


Tessenderlo Kerley

Crop Vitality

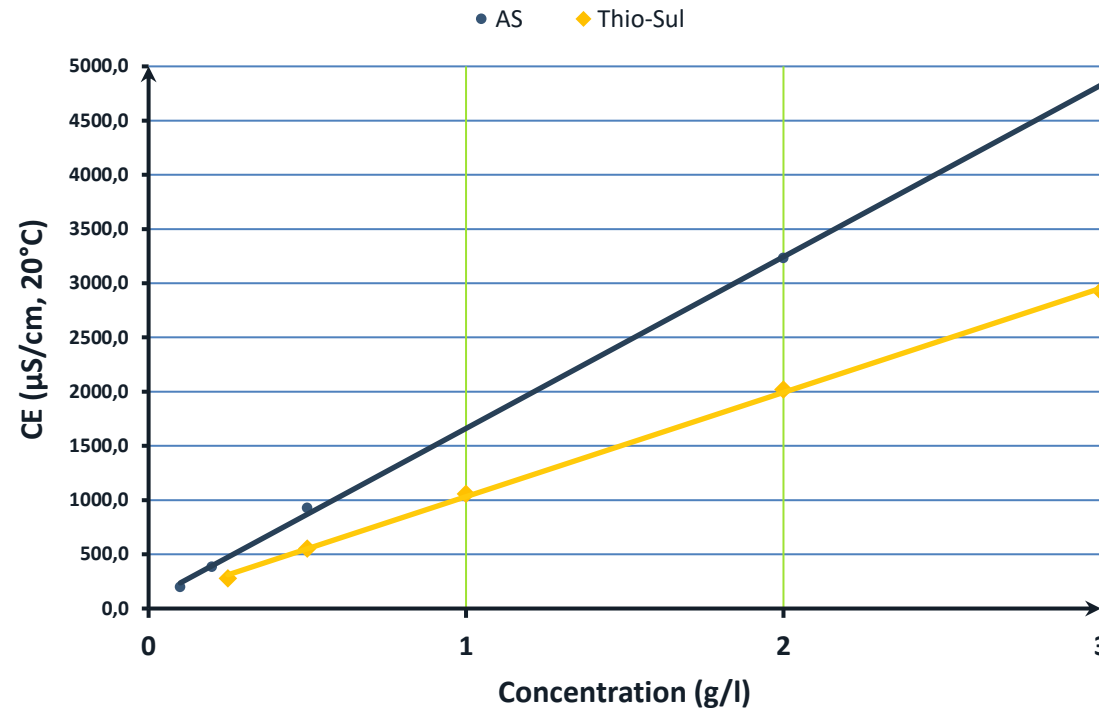
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ELECTRICAL CONDUCTIVITY



ELECTRICAL CONDUCTIVITY

CE ($\mu\text{S}/\text{cm}$) Thio-Sul[®] vs Ammonium Sulphate



Take home message

- Thiosulphates reduce oxidized micro nutrients in soil making them more plant available in increasing uptake
- By reducing oxidized iron in soil, phosphate fixed in iron oxides and hydroxide crystal structure becomes available for plant uptake
- Thiosulphates act as temporary inhibitor of nitrogen volatilization and nitrification, increasing Nitrogen Use Efficiency



kundige spesialis
ondersteuning

begin op die plaas



THANK YOU!

