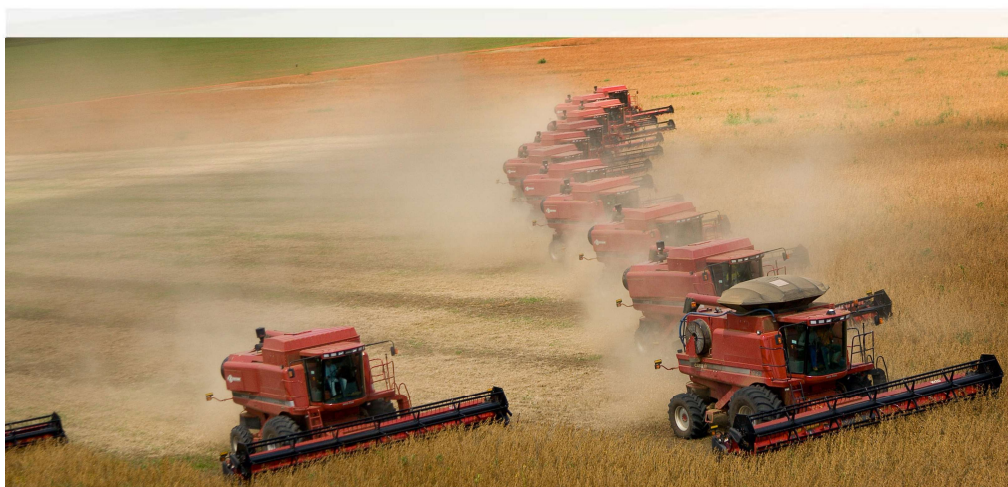
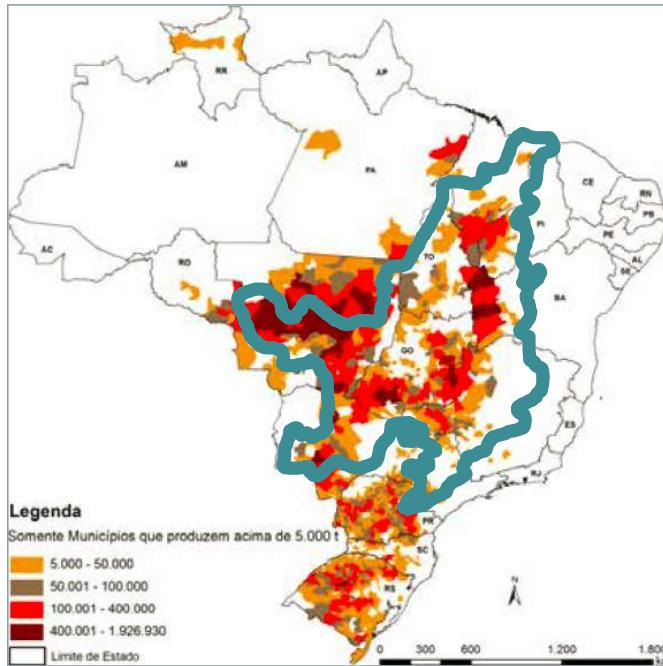


Soybean Fertilization with Polyhalite in Acidic Soils of the Brazilian Cerrado

Fabio Vale – IPI, Switzerland – Latin American Coordinator



Soybean in Brazil



■ Cerrado area

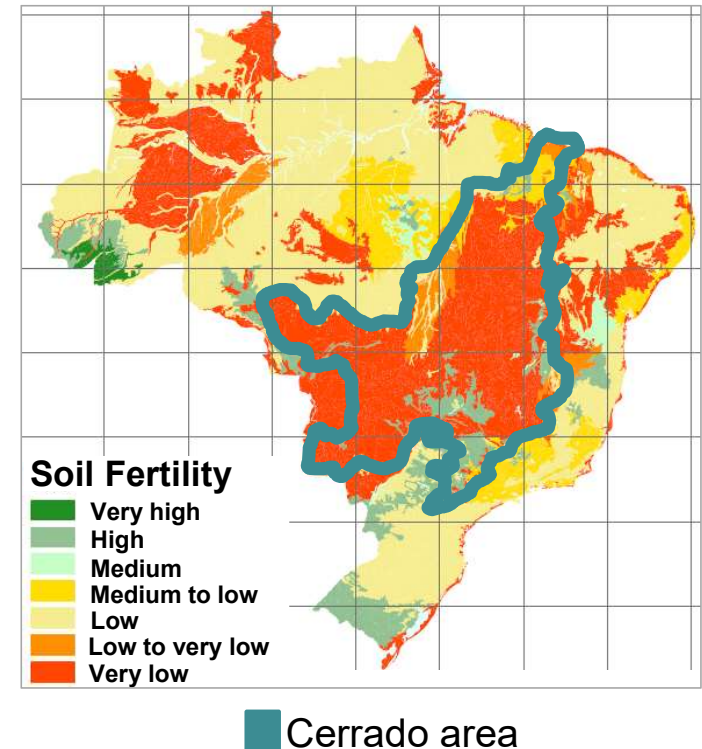
35,8 Mha (CONAB Sept 2019)
≈ 41% of grains area
≈ 14 M t fertilizers ≈ 39,4% of consumption
Yield → 3,200 kg/ha of grains
Champion areas → more than 7,000 kg/ha

- Cerrado area - Big ecosystem
 - 205 million ha (≈ 25% of Brazil area)
 - 63% of soybean production
- Very poor soils
 - 40% Oxisols
 - 20% Ultisols/Alfisols with high sand content in surface
 - 15% Entisols with high sand content
- Majority of areas with total dependence of fertilizers (sources and management)

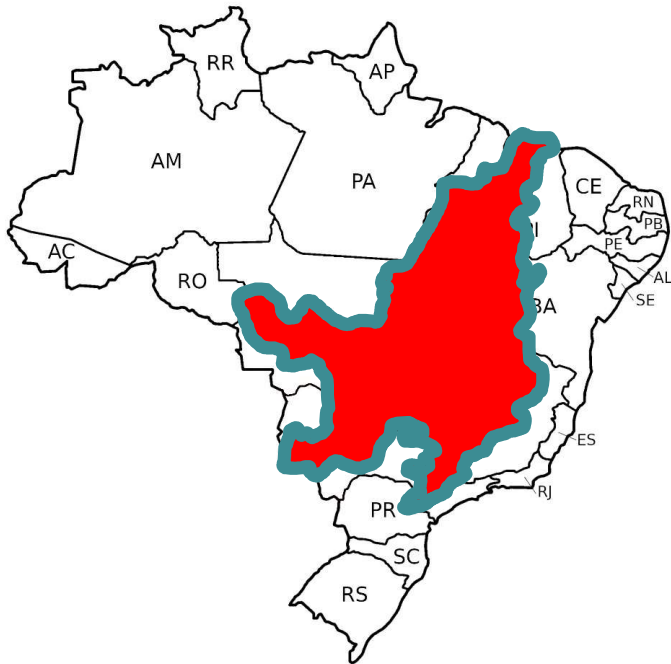


Soils in Cerrado

- Main characteristics of soil fertility in Cerrado
 - Acidity (surface and sub-surface)
 - High capacity of P fixation
 - Low CEC
 - Leaching of potash and sulphur
 - Poor in calcium, magnesium and micronutrients
 - Aluminum toxicity



Soybean in Cerrado

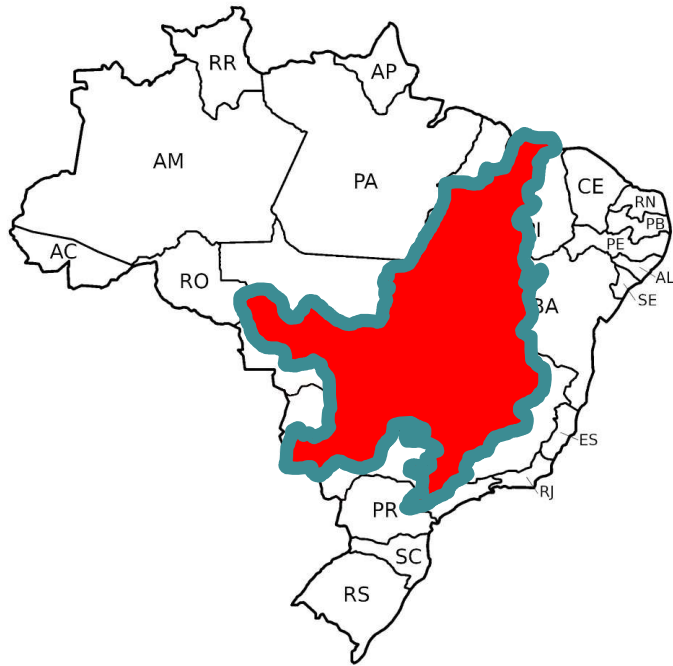


■ Cerrado area

- Big farms: broadcast fertilization
 - > 80% of potash; 50% of phosphorus
- Increasing potash deficiency
- More than 80% of area is in no-till system (limestone and fertilizers applied without incorporation)
- Ca and Mg from limestone are concentrated in top of soil (0-5 cm of depth)
- Roots are concentrated in top of soil and sulphur in depth

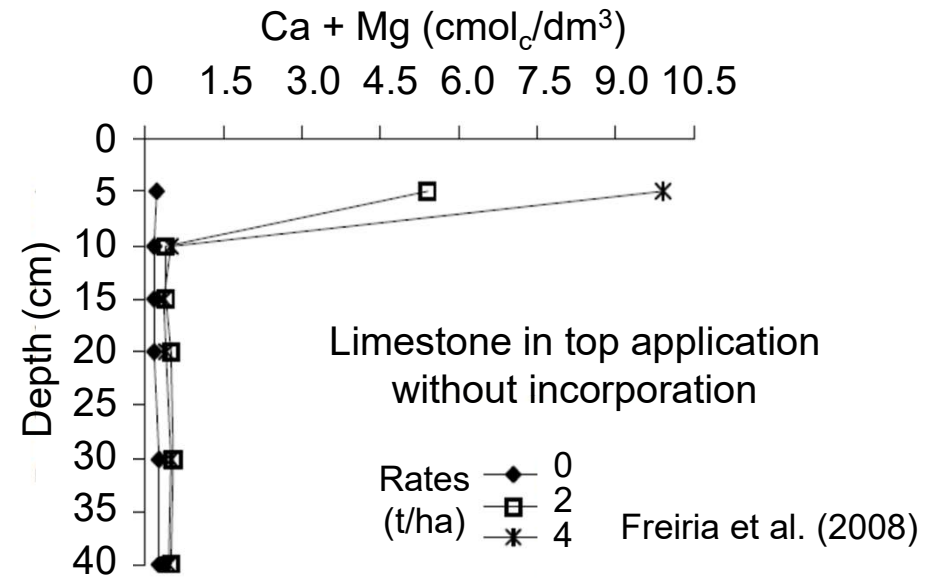


Soybean in Cerrado

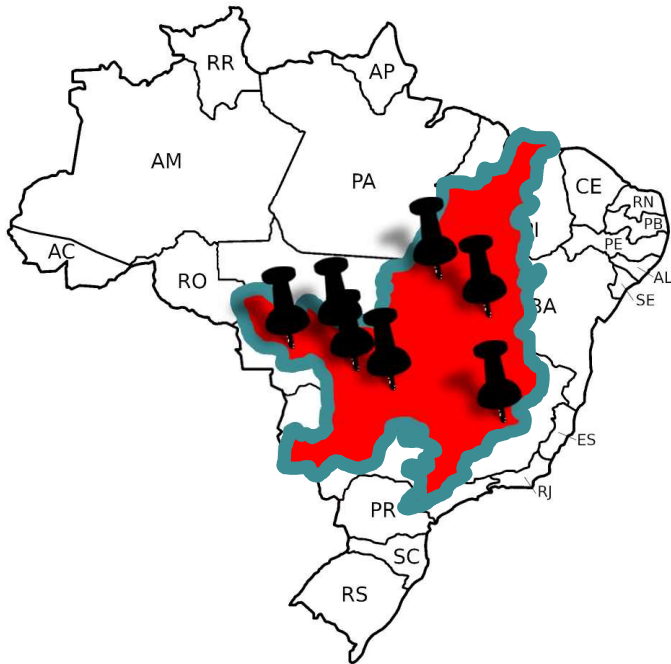


 Cerrado area

A big problem when there is lack of rain during flowering season



Soybean in Cerrado



■ Cerrado area

Opportunity to Polyhalite



- Solubility characteristics
- Lower leaching of S
- Mobility of Ca and Mg
- Balance of nutrients
- Reduction of salinity

- Since 2015 - 7 trials in Cerrado area evaluating Polyhalite
 - Two products - straight or Polyhalite compacted with KCl
- High potential to soybean crop in Cerrado
 - Increasing Ca and Mg in soil depth
 - More plants per area
 - Better nodulation
 - Increasing weight of grains
 - Increasing yield



Polyhalite to Soybean – First evaluation in Brazil (2015/16)



Polyhalite area

2,5 t/ha dolomitic limestone (broadcast and incorporated)

200 kg/ha MAP (furrow) – 104 kg/ha P_2O_5

1000 kg/ha Polyhalite (140 kg/ha K_2O – broadcast, 50% V2/50% V6)

190 kg/ha S + 120 kg/ha Ca + 36 kg/ha Mg

Farmer management (Amaggi, Sapezal, Mato Grosso state)

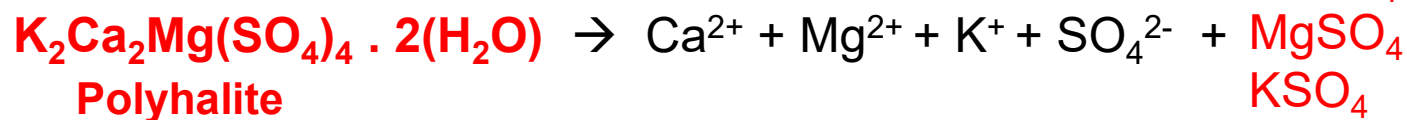
2,5 t/ha dolomitic limestone (broadcast and incorporated)

200 kg/ha MAP (furrow) – 104 kg/ha P_2O_5

235 kg/ha KCl (140 kg/ha K_2O – broadcast, 50% V2/50% V6)

Evaluation of Ca and Mg in Soil Profile

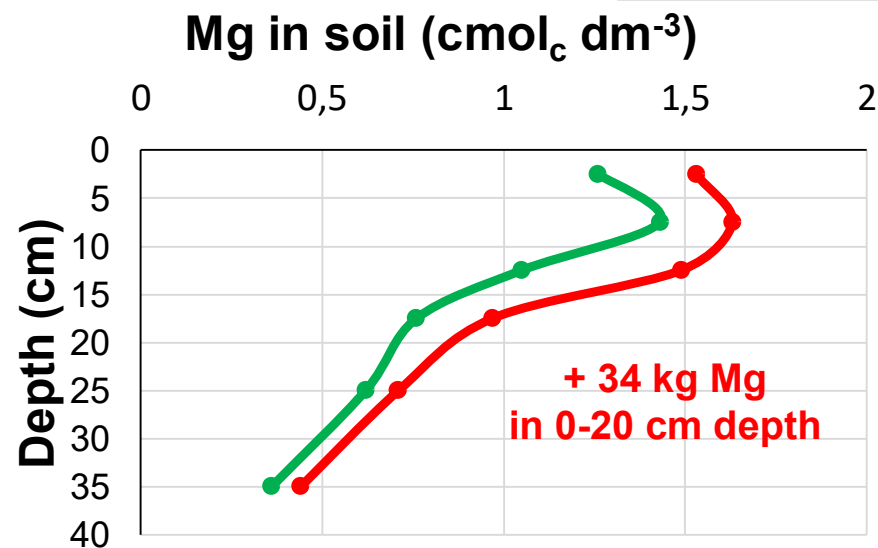
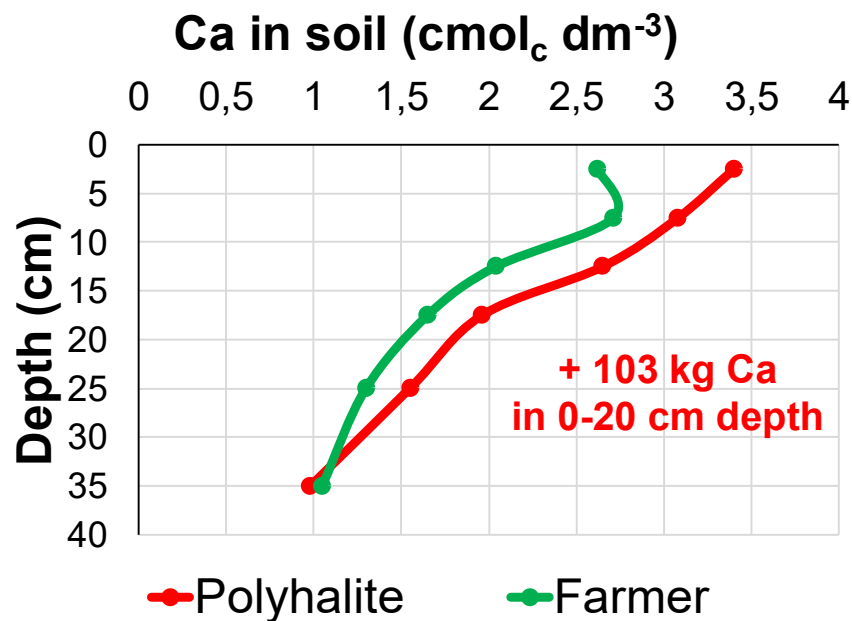
Ca and Mg associated with sulphate have mobility in depth of soil?



CaSO₄
MgSO₄
KSO₄

Ionic pairs

Evaluation: after soybean harvest, 10 soil samples were taken per area



Farmer – 2,5 t/ha limestone + 200 kg/ha MAP (furrow) + 235 kg/ha KCl (140 kg/ha K₂O – broadcast, 50% V₂/50% V₆)

Polysulphate – 2,5 t/ha limestone + 200 kg/ha MAP (furrow) + 1000 kg/ha Poly (140 kg/ha K₂O – broadcast, 50% V₂/50% V₆)



Vale, 2016

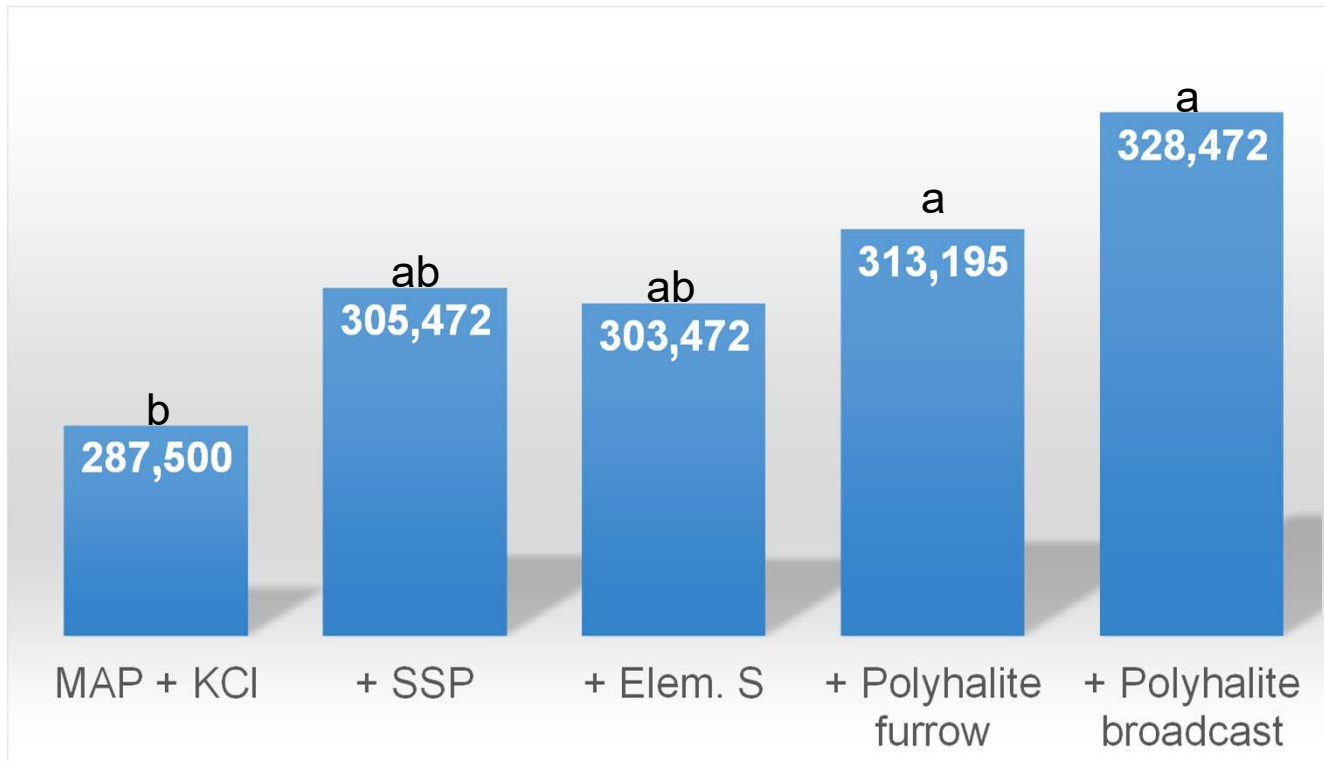
Soybean Trial (2016/17) – Mato Grosso state

- Management of S sources → Polyhalite, Single superphosphate (SSP), Pastilled elemental S (Elem S)
- Rates = 80 kg/ha P_2O_5 ; 80 kg/ha K_2O ; **25 kg/ha S**
 - In Poly plots were supplied **16 kg/ha Ca and 5 kg/ha Mg**
 - In SSP plot were supplied **37 kg/ha Ca**
- 5 treatments e 4 replications
 1. MAP (furrow) + KCl (broadcast) → control (0 S)
 2. MAP / **SSP** (furrow) + KCl (broadcast)
 3. MAP / **Elem S** (furrow) + KCl (broadcast)
 4. MAP / **Polyhalite** (furrow) + KCl (broadcast)
 5. MAP (furrow) + **Polyhalite** / KCl (broadcast)



Mg deficiency in treatment without Polysulphate (at R2 stage development)

Soybean Trial – Plants per ha – Mato Grosso state



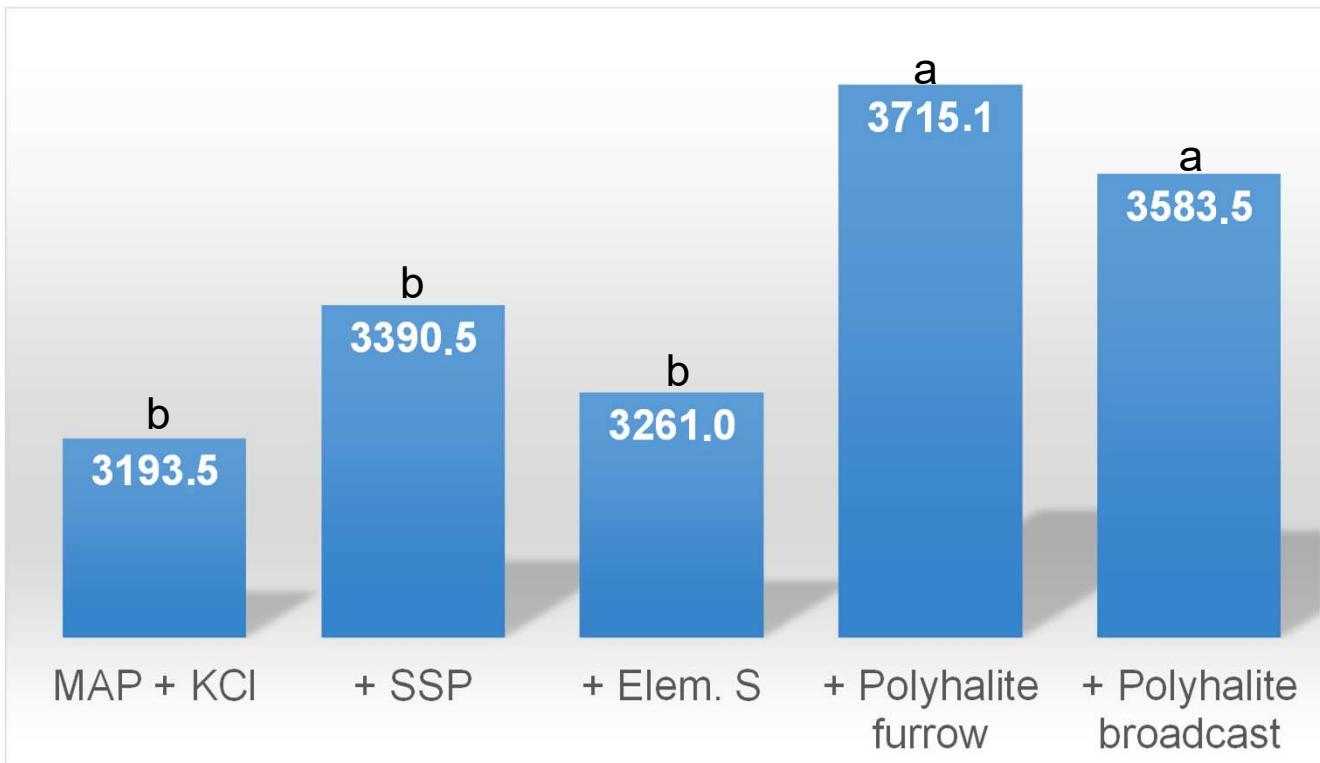
Tukey test 5%

- Polyhalite incremented number of plants per hectare
 - Better nutritional balance
 - Reduction of salinity

Pittelkow et al. (2018)



Soybean Trial – Grain Yield (kg/ha) – Mato Grosso state



Tukey test 5%

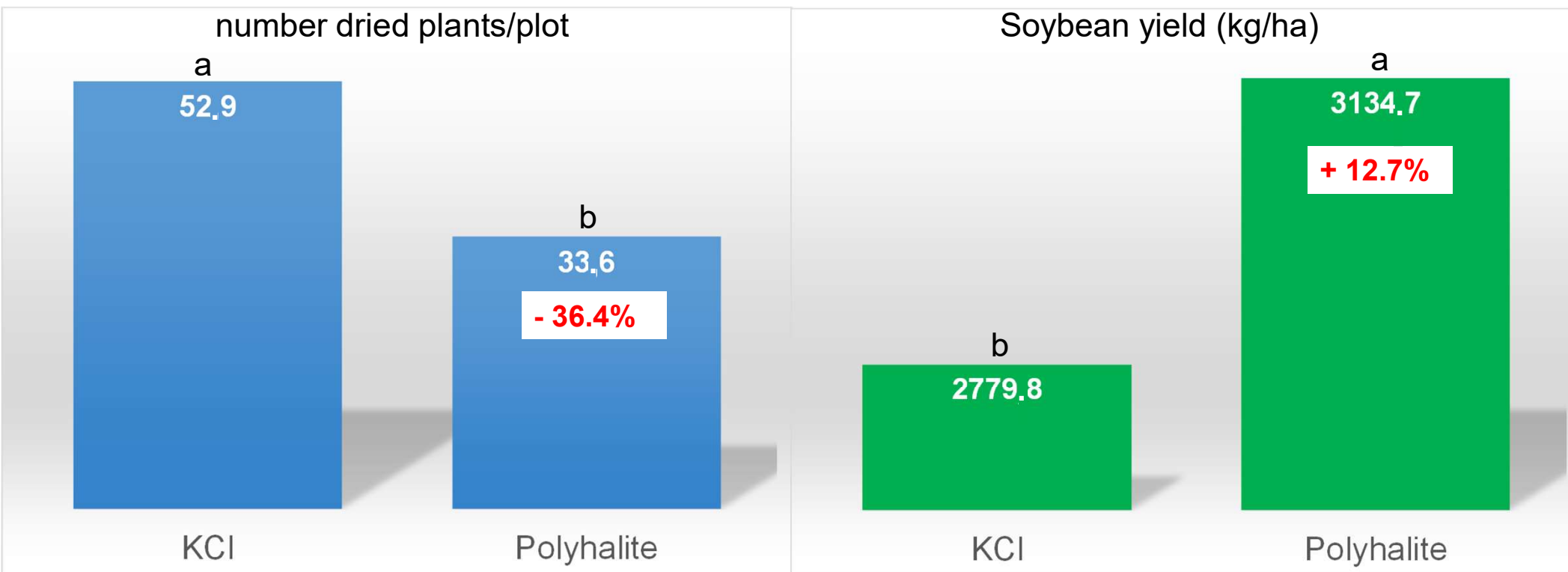
- Polyhalite was viable for use in soybean fertilization, both for broadcast or furrow application
- Polyhalite in furrow
 - + 16,7% in relation KCl (S, Ca, Mg)
 - + 14,1% in relation Elemental S (solubility)
 - + 9,7% in relation SSP (Mg)

Pittelkow et al. (2018)



Comparative KCl x Polyhalite – Tocantins state

- 80 kg/ha K₂O (furrow) - > salinity



Tukey test 5%



XXXVII CONGRESSO
BRASILEIRO DE CIÊNCIA
DO SOLO 2019
De 21 a 26 de Julho de 2019
Centro de Eventos do Pantanal - Cuiabá - MT

New Evaluation - Compacted Polyhalite + KCl



50% Polyhalite / 50% KCl compacted in same grain

00-00-37 + 9%S + 5.5%Ca + 1.5% Mg

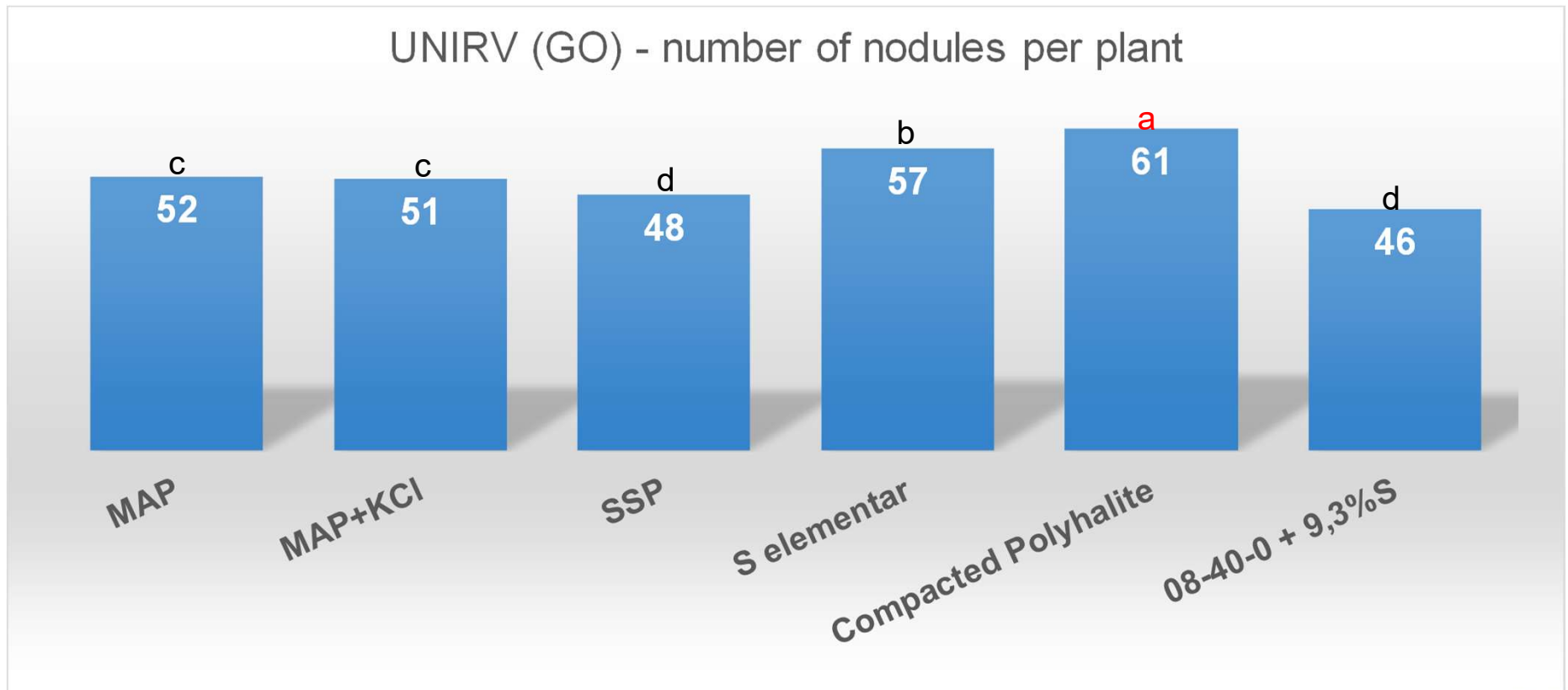
Soybean - Broadcast fertilization, before planting

- 3 trials in Cerrado of Brazil (2018/19)
- Rates: 17 kg/ha N, 80 kg/ha P_2O_5 , 80 kg/ha K_2O , **20 kg/ha S**
- 6 treatments e 4 replications
 1. Only MAP
 2. MAP + KCl (zero S)
 3. SSP as sulphur source
 4. Pastilled elemental S as sulphur source
 - 5. Compacted Polyhalite** as sulphur source (broadcast pre planting)
 6. 8-40-00 + 9.3% S (30% as SO_4 + 70% as S) at furrow

Compacted Polyhalite + KCl - Soybean

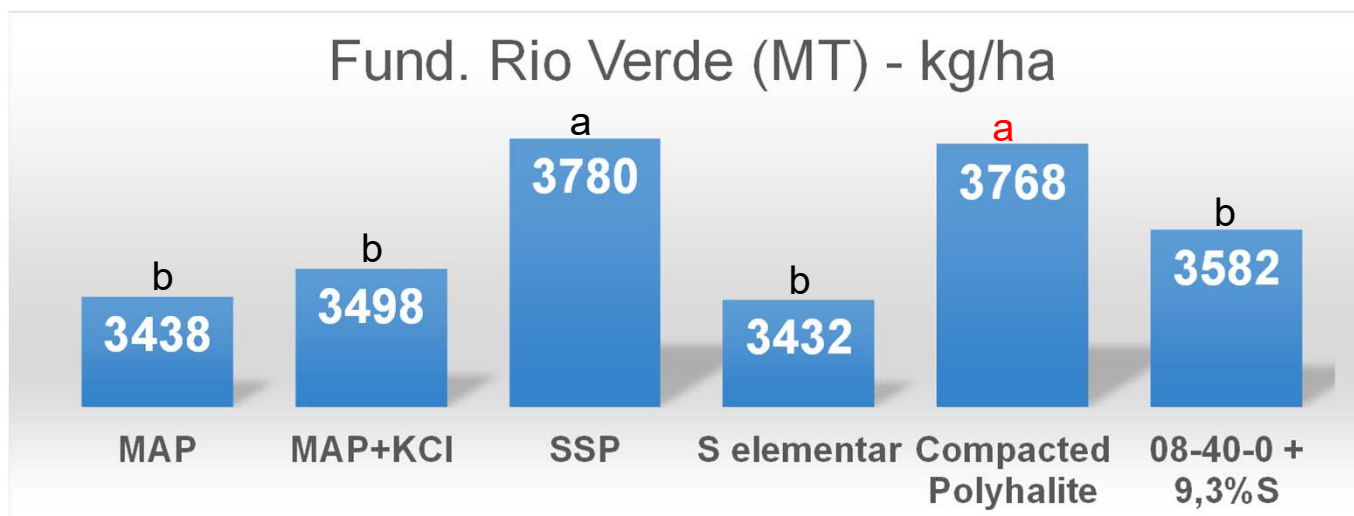
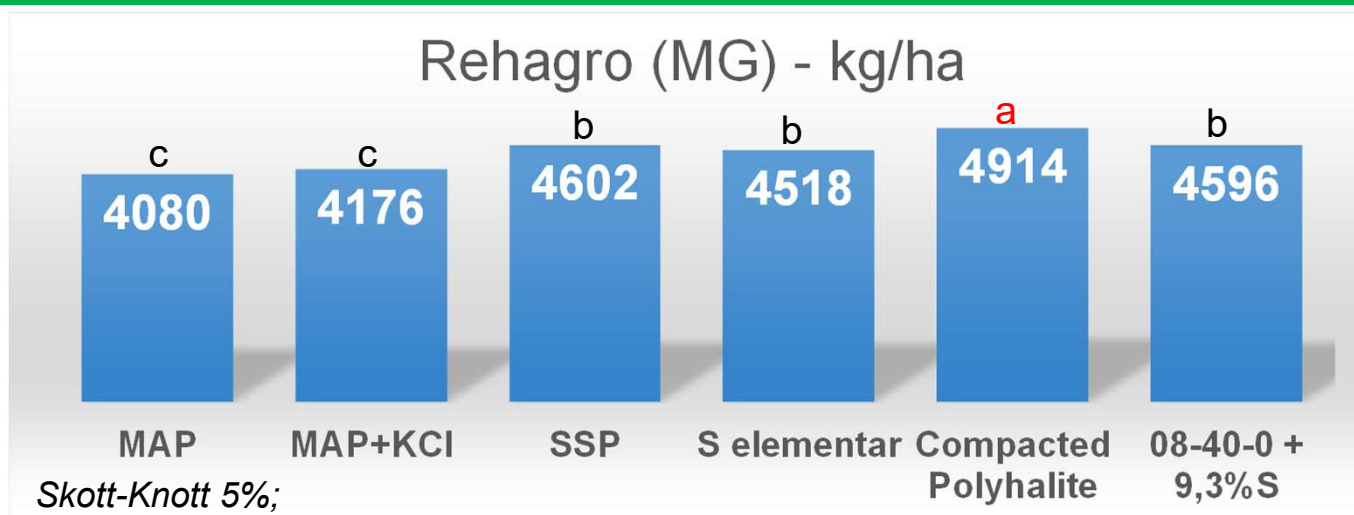
- Increment of number of nodules per plants

- Effect of nutritional balance (S, Ca, Mg) / salinity reduction



Skott-Knott 5%

Compacted Polyhalite + KCl – Soybean Yield (kg/ha)



Polyhalite for Soybean in Cerrado

Supply total amount of S,
Total or partial of K₂O
Ca e Mg with mobility

– Areas with low to medium/higher fertility

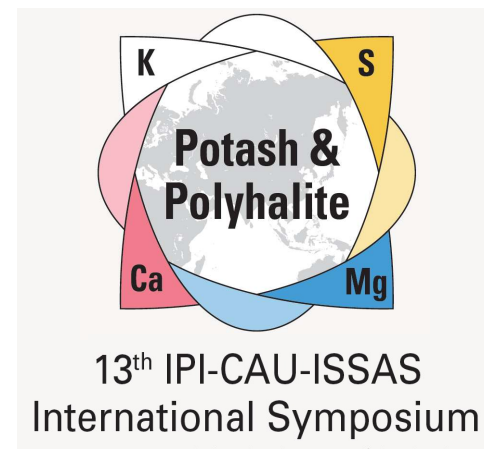
- ✓ 20 to 40 kg/ha of S (12-24 Ca; 4-8 Mg)
- ❖ 100-200 kg/ha **Polyhalite** (furrow), complementation with KCl in broadcast and pre-planting
- ❖ Or 200-400 kg/ha **Compacted Polyhalite + KCl** (broadcast and pre-planting)

– Areas with very low fertility (low Ca, Mg, S)

- ✓ Total rate of K₂O with **Polyhalite** (broadcast and pre-planting).

Yield	Nutrient	Uptake	Removed
		Kg/ha	
4,000 kg/ha of grains	K ₂ O	150	80
	Ca	48	12
	Mg	28	6
	S	60	20
		Very low	Low to high





THANK YOU - OBRIGADO

