



Technical Bulletin:

Polysulphate as a Magnesium Source

POLYSULPHATE[®]

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POLYSULPHATE® AS A MAGNESIUM SOURCE

Granular Polysulphate® is a natural mineral from underneath the North Sea that contains four nutrients: sulfur (19.2%), potassium (14% K₂O), magnesium (3.6%), and calcium (12.2%). It is a single complex crystal that is mined, crushed, then ready to use on agricultural fields. This multi-nutrient mineral (polyhalite) is sold by ICL as Polysulphate® and is OMRI certified, low in chloride and crop safe, suitable for use alone or in blends and compound fertilizers.

Increase in Mg Uptake with Polysulphate

1. As a slow-release mineral fertilizer for S, Mg, K and Ca, Polysulphate can reduce potential loss of Mg to leaching, while increasing Mg uptake. Compared to other cations like NH₄, K and Ca, Mg is more mobile and susceptible to leaching (Gransee & Führs, 2013).
2. Polysulphate contains 12.2% Ca compared to other common sources of soil-applied Ca like gypsum (calcium sulfate) that is ~23% Ca. The presence of Ca in Polysulphate can enhance Mg uptake in plants. For example, increasing Ca in the nutrient solution resulted in increased Mg root uptake except at remarkably high Ca concentrations (Figure 1 from Fageria, 2009).

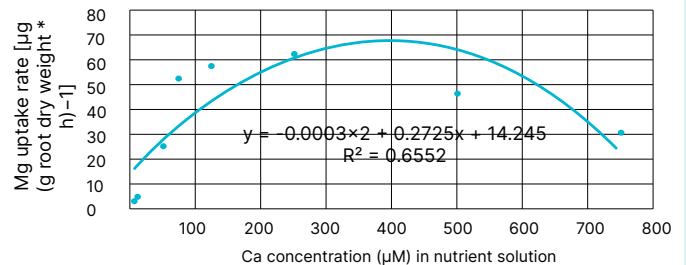


Figure 1. The effect of increasing Ca concentration in the nutrient solution on Mg root uptake (adapted from Fageria, 2009).

Features of Polysulphate Fertilizer

1. **Gradual release:** Natural multi-nutrient mineral fertilizer provides continuous supply of sulfur-based nutrients (S, Ca, Mg, K).
2. **Seed & Soil Safe:** low chloride, very low salinity index, neutral pH, no acidifying effect and safe to apply to sensitive crops.
3. **Flexible Usage & Versatile Application:** Excellent spread and blendability when broadcast, precision application in bands, and superb blendability and compatibility with other common fertilizers. Can be applied as a pre-plant, at planting, or post-harvest with proven results across various crops and soil types.
4. **Better, More Sustainable Growth:** OMRI-approved, low-carbon natural mineral. Enhances nutrient efficiency, soil structure, root development, water infiltration, and seed emergence.

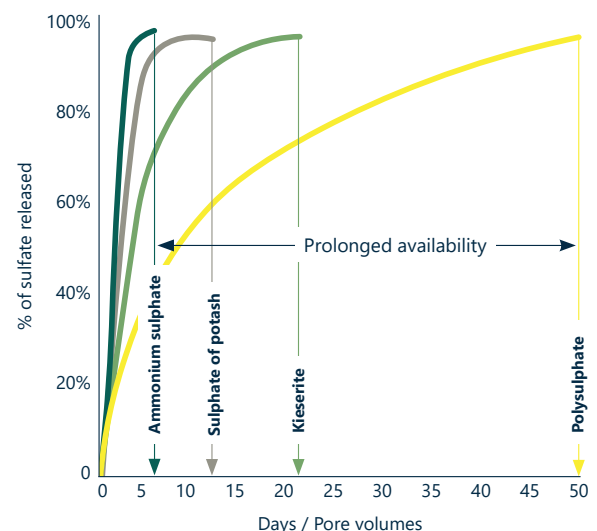


Figure 2. Sulfur release Source: U of Nottingham, UK, 2016.



Granular Polysulphate Application

Polysulphate offers flexible applications (preplant and incorporated, banded, or broadcast in the spring), use across all crops, conventional or organic, and a release pattern that matches crop uptake. See Table 1 for baseline rates based on S requirements.

Crop	Polysulphate Recommendation* (lbs./A)
Cereals (Wheat, Corn, Rice, Oats, Sorghum)	100-150
Legumes (Soybean, Peanuts, Peas & Clovers)	100-200
Hay crop (Alfalfa, Grasses)	200-300
Mustard (Cabbage, Broccoli, Mustard, Turnip, Radishes)	100-275
Cucurbits (Melon, Cucumber, Squash)	100-200
Oil seed (Canola, Cotton)	100-200
Tomato	100-200
Potato	200-400
Sweet potato	100-200
Pasture	50-100

Table 1. Polysulphate rates for various crops to meet the S fertilizer requirement.

* Polysulphate is a four nutrient mineral consisting of K₂O (14%), Ca (12.2%), Mg (3.6%), and S (19.2%). Therefore, these recommendation ranges are guidelines and should be adjusted based on soil test levels of K, Ca and Mg. *Soil test sulfur (S) is not entirely accurate and is highly variable based on topography, soil texture, sample depth, and organic matter. Sulfur soil test results should be used with caution with the understanding that the soil texture, organic matter, recent rainfall events may be more predictive of future S needs than a soil test.* These recommended ranges are based on estimated S removal.

Impact of Polysulphate on Magnesium Availability

- Increasing the Ca concentration to a certain level increases the uptake rates of Mg. Higher Mg concentrations in corn and cotton plant analysis with approximately 200 lbs./A of Polysulphate.
- Magnesium is more mobile in soil compared to other cations (NH₄⁺, K⁺ and Ca⁺⁺) making it more susceptible to leaching and more difficult to manage. Slow release of Mg by Polysulphate can increase Mg availability and reduce leaching loss.
- The high mobility of Mg makes it particularly challenging to relate soil test results to crop growth. Both soil and plant analysis are recommended to monitor and manage for Mg deficiency. Plant analysis shows sufficient supply of Mg in plants when using Polysulphate as the Mg source.

POLYSULPHATE®

- Higher Yield & Quality
- Increase nitrogen use efficiency
- Improve soil health as it helps to maintain soil structure for air and water movement



POLYSULPHATE®



Polysulphate® compared to potassium magnesium sulfate

Compared to potassium magnesium sulfate (SOPM) with ~11% of Mg, Polysulphate contains 3.6% Mg. However, research trials at the University of Georgia found Polysulphate compared to SOPM applied to supply either Mg (14 lbs. Mg/A = 400 lbs./A of Polysulphate or 133 lbs./A of SOPM) or K₂O (29 lbs. K₂O/A = 208 lbs./A of Polysulphate or 133 lbs./A of SOPM) resulted in similar or higher plant Mg concentrations for Polysulphate ((Figure 3 adapted from Barbier et al., 2017).

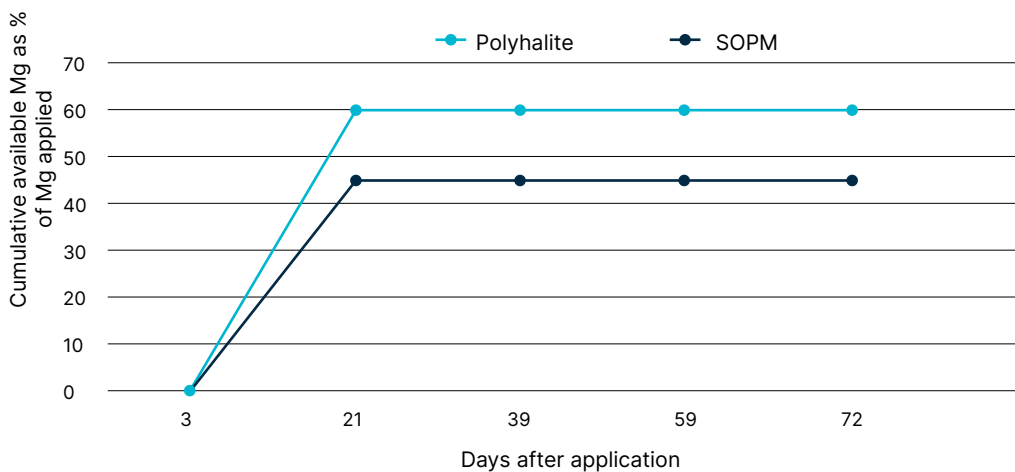


Figure 3. Polyhalite (69 lbs. Mg/A) resulted in more Mg for the crop to use (higher % cumulative available Mg compared to the amount applied) compared to SOPM (134 lbs. Mg/A) on a fine sandy soil with low organic matter (pH 6.7, soil test Mg of 14 ppm), (adapted from Barbier et al., 2017).

Polysulphate® as an Mg Source Trial Summary

Multi-year Evaluation of Mg Uptake in Cotton
Trial by Dr. Glenn Harris, UGA Tifton, GA

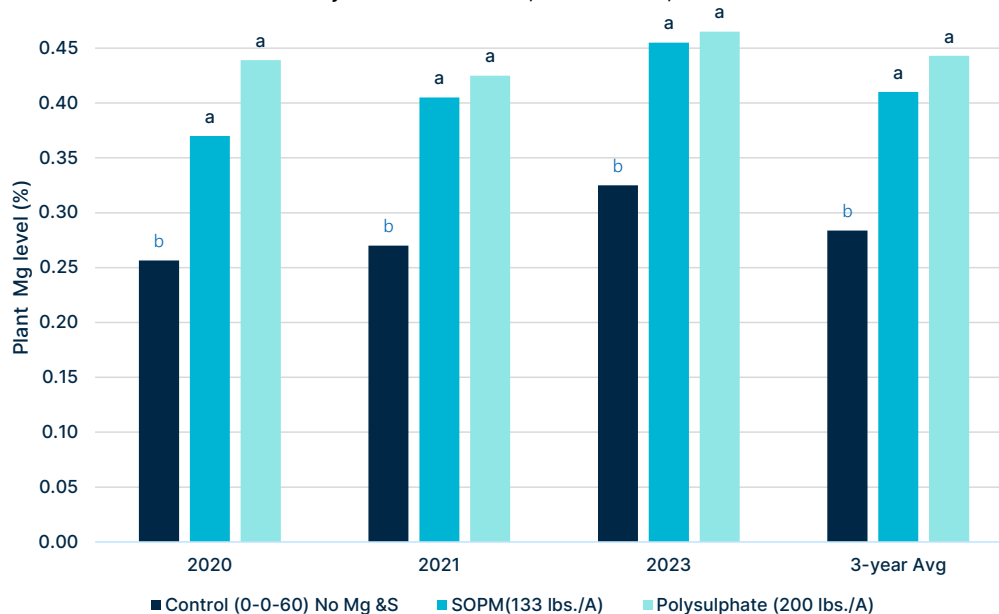


Figure 4. Three years study shows that using Polysulphate or SOPM made no difference in Magnesium (Mg) level needed for good crop growth. Both Polysulphate and SOPM were applied at rate to meet the crop sulfur requirement. Polysulphate applied at 208 lbs./A in 2020 and 2021 and 200 lbs./A in 2023 and SOPM was applied at 133 lbs./A in all three years.

**Means followed by same letter are not significantly different at P <= 0.10.*



Corn (2020)
Trial by Dr. Glenn Harris, UGA Tifton, GA

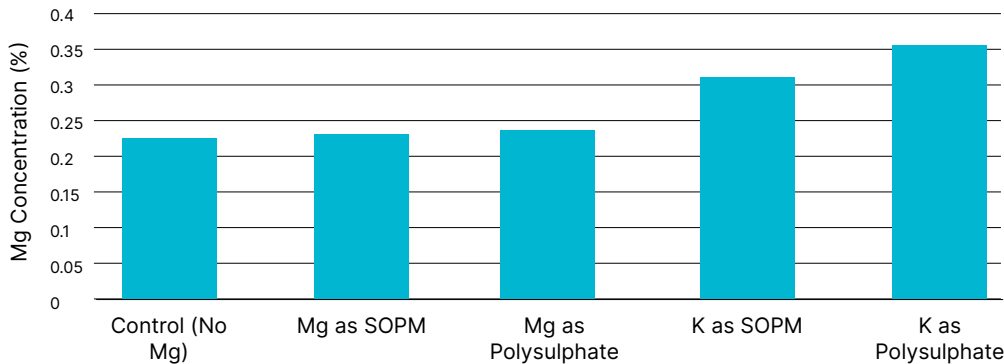


Figure 5 Corn tissue analysis comparing Mg concentrations from Polysulphate and potassium magnesium sulfate (SOPM). Polysulphate and SOPM applied based on Mg (14 lbs. Mg/A = 400 lbs./A of Polysulphate or 133 lbs./A of SOPM) or K₂O (29 lbs. K₂O/A = 208 lbs./A of Polysulphate or 133 lbs./A of SOPM).

Conclusion - Polysulphate a superior source of magnesium

- **Higher Magnesium Concentration in Plants:** Polysulphate (3.6% Mg) results in similar or higher plant magnesium concentrations compared to potassium magnesium sulfate (SOPM) and effectively increases Mg uptake.
- **Slow-Release for Enhanced Availability:** Magnesium's mobility in soil makes it prone to leaching. Polysulphate stabilizes Mg supply and its slow-release mechanism reduces leaching, enhancing its availability to crops.
- **Improved Magnesium Uptake with Calcium Synergy:** Polysulphate contains 12.2% calcium (Ca), which enhances Mg uptake in plants. Research indicates higher Mg root uptake with increased Ca levels from Polysulphate.
- **Effective Nutrient Management:** Plant analysis confirms sufficient Mg supply when using Polysulphate, supporting optimal crop growth. Both soil and plant analyses are recommended to manage Mg deficiency.
- **Comparison with Common Calcium Sources:** Polysulphate's Ca content supports Mg uptake, contrasting with gypsum (calcium sulfate, ~23% Ca). Compared with SOPM Polysulphate also proved to be a more efficient source of Mg.
- **Field Trial Validation:** Field trials over multiple years demonstrate that Polysulphate meets crop magnesium requirements effectively. Comparisons of Polysulphate and SOPM illustrate no significant difference in Mg levels needed for crop growth, making Polysulphate a optimal agronomic choice with additional benefits as a sustainable, multi-nutrient source.



For more information visit
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or contact our agronomy experts at:
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Source

- Barbier, Marcel, Yuncong C. Li, Guodong Liu, Zhenli He, Rao Mylavarapu, and Shouan Zhang. 2017. Characterizing polyhalite plant nutritional properties. *Agric Res Technol* 6, no. 3.
- Fageria NK. 2009. *The use of nutrients in crop plants*. CRC Press, Taylor and Francis Group, London.
- Gransee, A., & Führs, H. 2013. Magnesium mobility in soils as a challenge for soil and plant analysis, magnesium fertilization and root uptake under adverse growth conditions. *Plant and Soil*, 368, 5-21.