

STARTER FERTILISER FOR MAIZE

Effect of magnesium on nitrogen and phosphorus efficiency

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With the revised German Fertiliser Ordinance restricting the use of fertilisers containing nitrogen and phosphorus, we are urged to use these fertilisers as efficiently as possible. One established means of improving fertiliser efficiency in many crops is to apply 'starter fertilisers'. These granular fertilisers are placed in the furrow under the seed, making nutrients immediately available to it as it germinates.

Take maize, for example; nowadays it would be virtually unthinkable to grow maize without the use of starter fertilisers containing nitrogen and phosphorus, because numerous field trials have confirmed the fact that this practice promotes early growth and has a positive effect on yield and quality. But even here, there is still room to improve nitrogen and phosphorus efficiency.

The struvite effect

A scientific study conducted by the Institute of Plant Nutrition and Soil Science at the Christian-Albrechts-Universität zu Kiel (Kiel University) has shown that a struvite compound forms under the influence of moisture when the fertilisers diammonium phosphate (DAP)

(18% N; 46% P₂O₅) and ESTA® granular kieserite (25% water-soluble MgO + 20% water-soluble S) are combined in a ratio of 1:1 (Fig. 1). For this to happen, the two fertilisers do not necessarily have to be in direct contact in the granule band.

Struvite also forms when just 1% solutions of the two fertilisers come together. Struvite is an ammonium-magnesium phosphate which improves nitrogen efficiency by binding the nitrogen from the DAP in the form of ammonium, thus preventing too rapid nitrification and leaching.

Furthermore, since the phosphate from the DAP in the new struvite compound no longer has an affinity for calcium, it does not undergo ageing processes, especially in soils with a high pH or on freshly limed soils. The

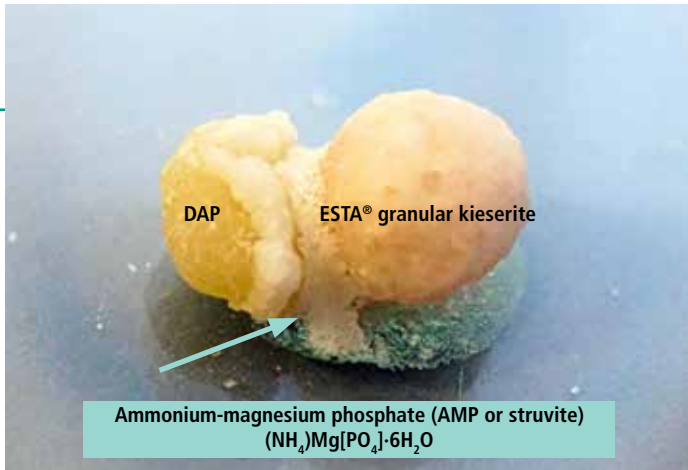


Fig. 1: Struvite formation when DAP and ESTA® granular kieserite combine (in a 1:1 ratio under the influence of moisture. This reaction also takes place in the granule band)

nutrients in the struvite compound (nitrogen, phosphorus and magnesium) remain fully available to the plant for a prolonged period, which is particularly beneficial in establishing early growth.

Sufficient magnesium for maize

Apart from the ability of the struvite compound to improve nitrogen and phosphorus efficiency, this starter fertiliser strategy also helps to ensure that the maize receives a targeted, demand-based supply of magnesium. A maize field yielding 55 t WM/ha takes up 50 kg of MgO/ha,

with demand increasing relative to yield increase. For example a high-yielding energy maize producing 80 t WM/ha requires more than 70 kg MgO/ha. However, since plants absorb magnesium by mass flow, a successful uptake is largely dependent on the availability of soil water. This means that during dry periods, the amount of magnesium available to maize crops that have a high demand for the element rapidly diminishes, regardless of whether the soil contains adequate magnesium concentrations or not. However, low concentrations of soil magnesium further exacerbate this effect. The worst-case scenario is low soil magnesium concentrations and dry soil during the crop's peak magnesium demand phase. ESTA® granular kieserite applied as a starter fertiliser offers a major benefit in such situations. Magnesium is present in ESTA® granular kieserite in the form of magnesium sulphate, which is 300 times more water-soluble than the forms

Tab.: Nutrient levels in digestate

Nutrient levels (kg/t fresh weight)	Nutrient availability (CaCl ₂)	Assessment
Nitrogen (N): 4–5 of which ammonium (NH ₄ -N): 2–3	40–60 % 70–90 %	medium high
Phosphorus (P ₂ O ₅): 1,5–2,0	60–70 %	medium high
Potassium (K ₂ O): 4,5–5,5	90–100 %	very high
Magnesium (MgO): 0,6–1,0	15–20 %	low
Sulphur (S): 0,3–0,4	–	very low!

HIGHER LEVELS OF MAGNESIUM AND SULPHUR REQUIRED

(n = 249 samples from 2005–2008, amended as per Dr. Kluge, LUFA Augustenberg, 2009)

of magnesium that are more commonly found in the soil (Mg oxide/hydroxide) or that are present in lime fertilisers (Mg carbonate). Thus the ESTA® granular kieserite fraction of the starter fertiliser supplies a significant proportion of the magnesium supply that is required throughout the important stage of early growth in a readily available form, even under dry conditions.

Closing nutrient gaps and avoiding nutrient antagonism

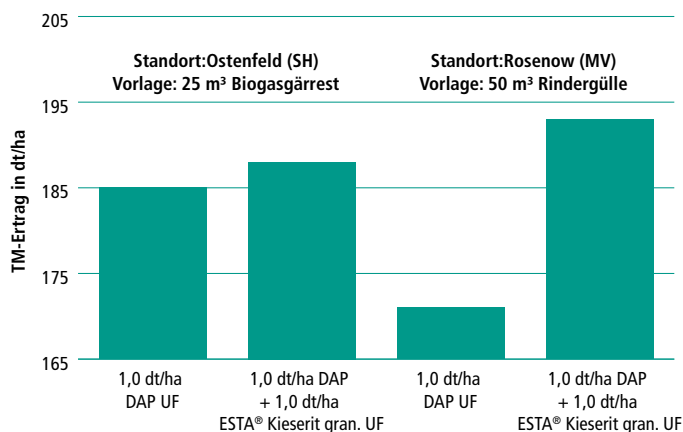
Since farmers generally apply high levels of organic farmyard waste (especially biogas digestate and cattle slurry) to maize in addition to the starter fertiliser, problems associated with magnesium deficiency often arise due to nutrient antagonisms which inhibit the successful uptake. These antagonistic interactions occur mainly between ammonium and magnesium, as well as potassium and magnesium. It is clear from the table above that the magnesium content of digestate is significantly lower than the ammonium and potassium content. And it is present in a far less available form. This disparity applies to organic farmyard manure in general and can block the uptake of magnesium.

Here too, this inhibiting effect is further exacerbated by drought and deficient levels of soil magnesium. For these reasons, it is important to ensure a balanced ratio of available magnesium when using organic farmyard manure. A starter fertiliser combining DAP with ESTA® granular kieserite closes these gaps and ensures balanced plant nutrition – which is entirely in the spirit of Liebig's Law of the Minimum, which states that any deficiency of one nutrient will severely limit the efficiency of others.

Field trials also show good results with DAP and ESTA® granular kieserite (Fig. 2).

Especially in areas where magnesium can easily be problematic for the reasons cited above, a starter fertiliser comprising DAP and ESTA® granular kieserite in a 1:1 ratio [NP 9 + 23 (+ 12 + 10)] has been shown to significantly boost yields. We can go a long way towards overcoming the challenges presented by the new Fertiliser Ordinance by exploiting the struvite effect to make more efficient use of nitrogen and phosphorus and closing nutrient gaps for magnesium and sulphur to make a balanced supply of nutrients available to maize.

Fig. 2: Yield results from starter fertiliser trials in silage maize



from 2015 and 2016 from 2 sites: Rosenow, Mecklenburg-Western Pomerania; Ostenfeld, FH-Kiel test station, Schleswig-Holstein

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