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Influence of different nitrogen inhibitors on maize yield

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Nitrogen (N) fertilizer management is challenging due to the many factors and have low N use efficiency (NUE). Heavy N losses from soil reduce plant yield and have negative impacts on the environment. Nitrogen processes inhibitors, such as urease and nitrification inhibitors (UI and NI), are chemical compounds which reduce urea hydrolysis and nitrification respectively. By coating ammonium based chemical fertilizers with N process inhibitors allows N to stay in a more stable form of ammonium (NH_4^+) thus minimising N losses as well as improving NUE and consequently enhancing crop yield.

A field experiment was established at the Soil and Water Management and Crop Nutrition Laboratory (SWMCNL) in Seibersdorf, Austria to determine the effect of different N fertilizers coated with N process inhibitors on maize yield in summer 2020. The field site is characterised by a moderately shallow Chernozem soil with significant gravel content. Three combinations of N fertilizer (urea or NPK) with N process inhibitors (UI and/or NI) were tested and compared with a control treatment (without N fertilizer) and a urea application without any inhibitor. All treatments received $60 \text{ kg ha}^{-1} \text{ P}_2\text{O}_5$ and $146 \text{ kg ha}^{-1} \text{ K}_2\text{O}$. The amount of N added to each treatment receiving N fertilizer was 120 kg N ha^{-1} . The inhibitors used were (i) UI (2-NPT: N-(2-nitrophenyl) phosphoric acid triamide), (ii) NI-1 (MPA: N-[3(5)-methyl-1H-pyrazol-1-yl] methyl] acetamide), and (iii) NI-2 (DMPP: 3,4-dimethylpyrazole phosphate). DMPP, a nitrification inhibitor, was used in combination with NPK fertilizer. A randomized complete block design with four replications was used in this study. Treatments were: T₁ (control treatment - without N fertilizer), T₂ (Urea only), T₃ (Urea + UI), T₄ (Urea + UI + NI-1), and T₅ (NPK + NI-2). Urea was applied through two split applications in the T₂ treatment. In T₃, T₄, and T₅ treatments, N fertilizers were applied only once. Supplemental irrigation was only applied in the early stages of growth, to ensure that the crop could establish. Harvest was carried out at 98 days after planting.

The yield data showed that different fertilizer treatments had a significant ($p \leq 0.01$) effect on maize yield (dry matter production). There was no significant difference between treatments 4 and

5, which had the highest yield followed by treatments 2 and 3. The comparison between T_2 and T_3 showed that the application of a urease inhibitor avoids the need for a split application of urea, which decreases labour costs. Adding NI-1 (under T_4) further increases the yield. Also, the package of NPK, a common choice by farmers in Austria, in combination with the nitrification inhibitor NI-2 showed equally good results as urea combined with two inhibitors. Based on the yield results, it can be concluded that N process inhibitors play a significant role in enhancing maize yields.