Connecting soil nitrogen availability and crop yield for a greener agriculture

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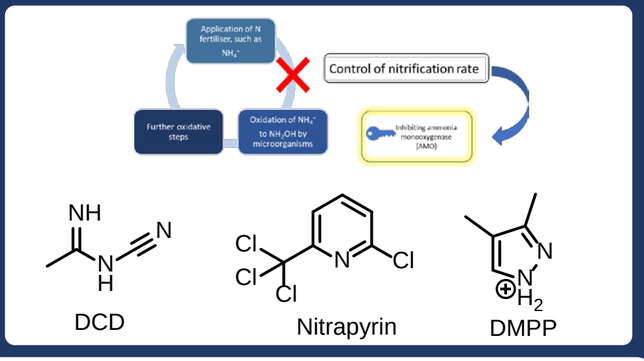
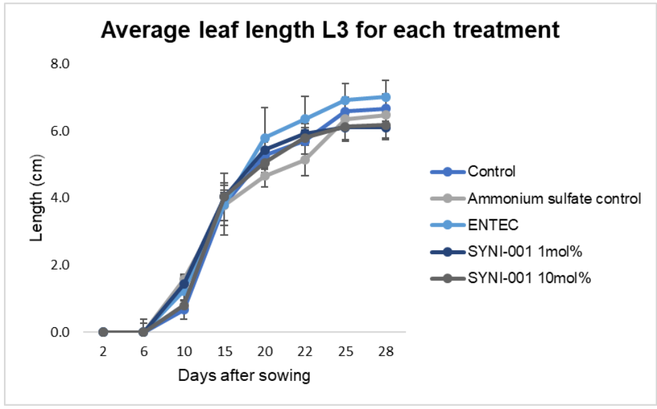
Introduction:

- The microbial conversion of nitrogen in agriculture is an undeniable challenge, since high rates of N are introduced into the soil (up to 120 Tg per year)
- Up to 70% of the introduced N is converted by chemolithoautotrophs to nitrate and gaseous forms of N, such as the greenhouse gas NO and N_2O
- Commercial nitrification inhibitors (NI) are preventing this process, however their performance is unpredictable in many climate conditions and soil compositions
- NI like Nitrapyrin®, DMPP® and DCD ® are believed inactivate the key step of nitrification, the oxidation of ammonium to hydroxylamine by the ammonia monooxygenase (AMO) and are applied with N fertilisers, however no evidence has been shown for the inhibitory mechanism of AMO of these compounds and their effect on plant growth



Results:

- The initial pot experiments were performed with the model plant Brachypodium distachyon (BD), which belongs to of the grass family Poaceae that includes the most important crops plants like wheat
- In a temperature-, water-content-, nutrient-controlled experiment, the growth of BD was measured and plotted against the time
- The treatments included Control, Ammonium Sulfate Control (N fertiliser), ENTEC® GranAm (commercial N fertiliser including NI), a novel suggested heterocyclic compound SYNI-001 (applied N fertliser, in two different concentration 1 mol% and 10mol%)
- The suggested inhibitor showed for all leaves a slower growth (in Figure 1 only L3 is shown), whereas the leaves of the control treatments showed especially between day 6 – 10 a better growth. The root and shoot dry weight of the suggested compounds were generally lower, which indicated that the compound has a impact of the plant's overall growth, therefore new compounds with different side groups are going to be tested in the future



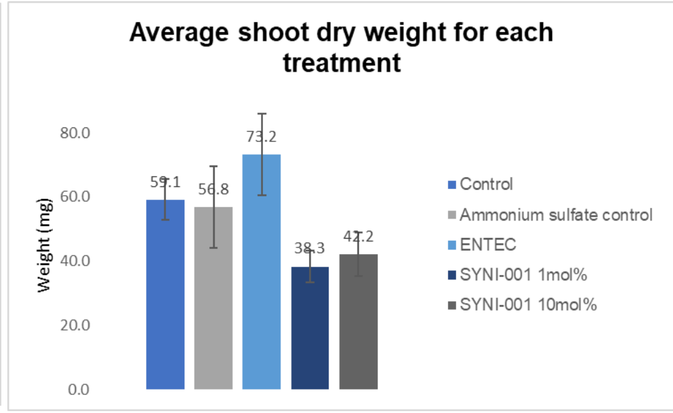
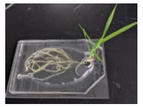


Figure 2: L: Growth curve (cm) of L3 over time of Brachypodium distachyon in a 28 day growth chamber experiment R: Average shoot dry weight after harvesting BD in a 28 day growth chamber experiment (T = 35 °C, water holding capacity = 60%, Control MilliQ Water, Ammonium Sulfate Control = ammonium sulfate 100 mg/kg. ENTEC® = commercial nitrification inhibitor, SYNI-001 = new suggested compound in 1 mol% and 10 mol% formulated with 100 mg/kg ammonium sulfate.

Future Work



- Colorimetric bacterial assays with *Nitrosomonas europaea* to determine inhibitors that reduce nitrification rate to determine nitrification inhibiting inhibitors
- The next step are experiments in 3D printed hydroponic systems, known as EcoFabs® are used to design a standardised experiments to track plant growth, control nutrient availability and to simultaneously scan the roots
- Root scanning via Magnetic Resonance Imaging to will be the final work, which links nitrogen availability with the development of the root architecture

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