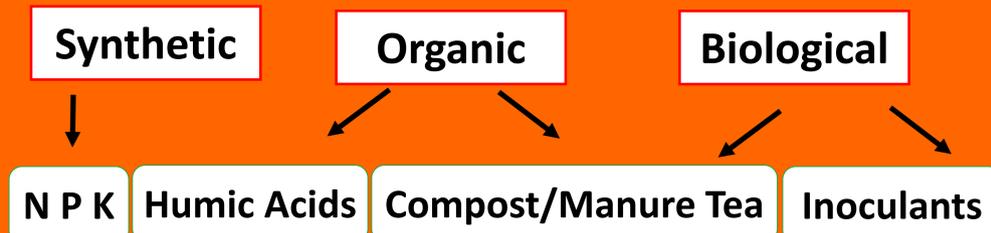


Introduction

- Sustainable agriculture production depends on the development and use of methods that optimize nutrient cycling, minimize use of external inputs, and maximize input use efficiency according to the conditions of each region.
- The principle of an integrated plant nutrition system (IPNS) is the balanced supply of appropriate nutrients to ensure that all the essential nutrients are available to match the crop demand, taking advantage of the combined use of **synthetic**, **organic** and **biological resources** to maintain the soil fertility over the long-term.



- Rationale:** Synergetic effects from the combination of biological/organic sources and inorganic fertilizer could be result in improved agronomic, economic and environmental outcomes. **WHY HUMIC ACIDS and BIOFERTILIZERS?** Laboratory studies have shown that humic acids stimulates microbial activity as important ion exchange and metal complexing (chelating) systems (Puglisi, Fragoulis et al. 2009). Also, it increases the production of micelium by mycorrhizal fungus (Gryndler, Hrselová et al. 2005).

Objectives

- Investigate the integrated use of synthetic, organic and biological fertilizer resources in rowcrop rotations in the Mid-Atlantic United States.
- Evaluate the effects of commercial nitrogen (N) fertilizers, humic acids compounds (HA), compost/manure teas (CT) as inorganic, organic and biological resources, respectively and their synergy on corn (*Zea mays* L.) growth and soil properties.
- Define optimum application rate and timing for one aerobically and one anaerobically derived compost/manure tea product and humic acids commercial compound.
- Calculate the economic viability of this integrated practice.

Materials and Methods

- Greenhouse (Ongoing study):** two different HA products (Monty's and HumiK granule); two CT products (SoilSoup and Microgeo); and the combination of HA and CT products (Monty's + SoilSoup and Monty's + Microgeo) were tested at levels of: control; 0.5; 1 and 2 times the labeled rate; applied as a soil drench along appropriate levels of NPK and adjusted pH.
- 50% of playground sand + 50% of Metromix 360 were placed in each polyethylene pot and two corn seeds were planted in each pot and thinned to one after germination. Pots were maintained at 60% of field capacity to ensure adequate moisture.
- Plant height and NDVI (Greenseeker[®]) measurements were collected at days 20 and 40 post-emergence. Also, at day 40, plants were harvested and dried at 70 °C for dry matter yield measurement and nutritional analysis.
- Field trials:** Initial field trial were conducted at Kentland farm, near Blacksburg, VA.
- Treatments consisted of: 1) Control (only inorganic fertilizer) 2) HA + inorganic fertilizer 3) CT + inorganic fertilizer 4) HA + CT + inorganic fertilizer, each at two inorganic N fertilizer rates, 0.80x and 1x of the recommended total N rate based on corn yield goal in a randomized complete block design with a factorial arrangement and four replications. Organic and biological rates were consistent with label recommendations for those products. Corn were planted in 30 inch rows and plot size were 4 rows (10 ft) wide by 25 ft in length.
- Plant parameters: plant height, plant greenness (0-10), plant vigor (0-10) and Greenseeker[®] readings, grain yield and grain nutrient concentration. (Grain harvest is not done).

Results



Fig. 1. First readings: Anova table, plant height, NDVI, greenness and vigor.



Fig. 3. Third readings: Anova table, plant height, NDVI, greenness and vigor.



Fig. 5. Fifth readings: Anova table, plant height, NDVI, greenness and vigor.

Literature Cited

- Gryndler, M, H Hrselová, R Sudová, H Gryndlerová, V Rezacová, and V Merhautová. "Hyphal Growth and Mycorrhiza Formation by the Arbuscular Mycorrhizal Fungus *Glomus Claroideum* Beg 23 Is Stimulated by Humic Substances." *Mycorrhiza* 15, no. 7 (2005): 483-88.
- Puglisi, Edoardo, George Fragoulis, Patrizia Ricciuti, Fabrizio Cappa, Riccardo Spaccini, Alessandro Piccolo, Marco Trevisan, and Carmine Crecchio. "Effects of a Humic Acid and Its Size-Fractions on the Bacterial Community of Soil Rhizosphere under Maize (*Zea Mays* L.)." *Chemosphere* 77, no. 6 (2009/10/01/ 2009): 829-37.



Fig. 2. Second readings: Anova table, plant height, NDVI, greenness and vigor.



Fig. 4. Fourth readings: Anova table, plant height, NDVI, greenness and vigor.

- Control values were lower than the treatments in the most of the cases. However, differences were not statistically significant in all readings.

Discussion/Future Research

- Opposing the first four readings, the control values were higher in the last reading (Tasseling). Therefore, these bio-stimulants might be more effective during the early vegetative stage. Once the plants are tasseling, they already reached the genetic potential in terms of height and chlorophyll amount.
- A growth chamber study will be conducted in order to clarify the hormones effects of this compounds, then another greenhouse study will be set including more plants/soil parameters as root biomass and soil porosity. Field trials will be based on these results.
- Potentially, a side project addressing turfgrass will be conducted to test the effectiveness of this integrated practice in different fields.