GRIMM FAMILY CENTER FOR ORGANIC PRODUCTION AND RESEARCH

ORGANIC PHOSPHORUS DYNAMICS:

Organic phosphorus (P) is essential for high crop yields, but but global P reserves are depleting. Both conventional and organic growers could benefit from algae as a potential bio-based substitute. Since P often becomes locked in soil and some soils have low P availability, this study aims to compare the P availability and mineralization rate of algae to other synthetic and organic fertilizers across soils with varying textures and P statuses.

INCUBATION EXPERIMENTAL DESIGN

- An incubation trial was conducted to determine P dynamics following the application of 4 fertilizer products to 4 soils, each treatment replicated 4 times.
- 5 Fertilizer treatments: algae, bonemeal-derived organic fertilizer pellets (OP), diammonium phosphate (DAP), synthetic fertilizer blended with humic acid (HA), and an unamended control.
- 4 Soil types: coarse-textured low P status, coarse-textured high P status, fine-textured low P status, and fine-textured high P status.
- Fertilizers were added at 100 mg P/kg soil.
- N addition rates: 90 mg N/kg soil for DAP, 39 mg N/kg soil for HA, 523 mg N/kg soil for OP, and 302 mg N/kg for algae.
- Soil pore water samples were collected weekly for three months to analyze ammonium, nitrate, and phosphate concentrations.
- P concentrations were measured via the Olsen P method at the end of the incubation.

Fig. 1: 80 incubation samples

SOIL PORE P RECOVERY FINDINGS

- In coarse and fine high P status soils, synthetic fertilizers had higher P recovery in the pore space than organic pellet fertilizer, but no difference was observed between synthetic fertilizers and algae.
- The lowest fertilizer P recovery was observed in fine low P status soil.
- Less than 5% of the added P was recovered as phosphate in the soil pore water across all treatments.

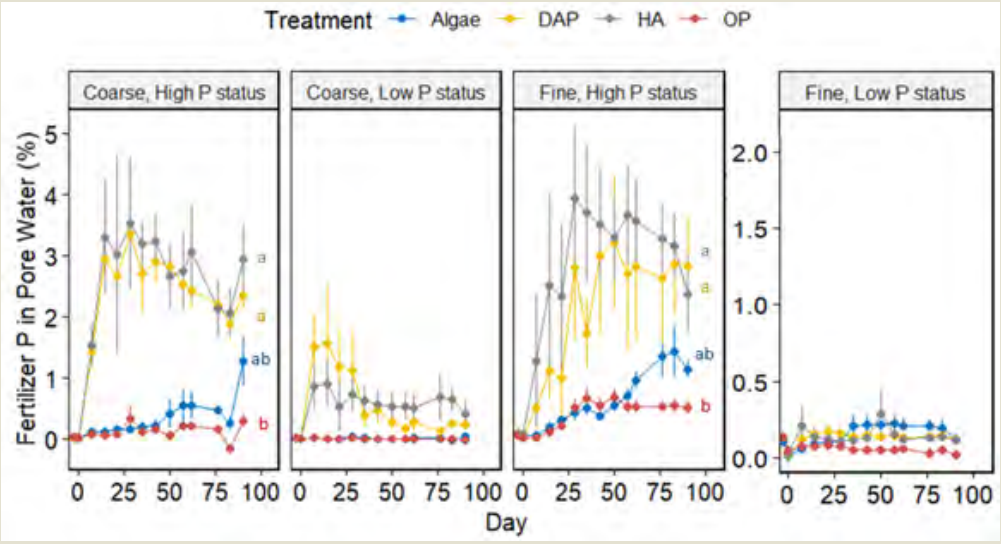

Fig. 2: Soil pore phosphorus for the tested soils and fertilizers

- **Soil P status affected phosphorus availability more than texture**
- **Fine soils with low P status showed lowest fertilizer P recovery**

Zander Brant, Anna Rodriguez-Paiatsyka, & Dr. Charlotte Decock

https://organic.calpoly.edu/

CAL POLY College of Agriculture, Food & Environmental Sciences

P RECOVERED IN OLSEN P POOL

- Recovery of fertilizer P in Olsen P pool range from 4 – 178 %
- Olsen P for DAP was significantly higher than OP in coarse low P and fine high P soils
- Olsen P for HA was significantly higher than organic pellet in fine high P soil

- **P status affected fertilizer recovery of Olsen P in the fine textured soils, but not in the coarse textured soils.**
- **Low recovery of fertilizer P in Fine soils with low P status**
- **Algae fertilizer and OP had comparable Olson P across soil types**

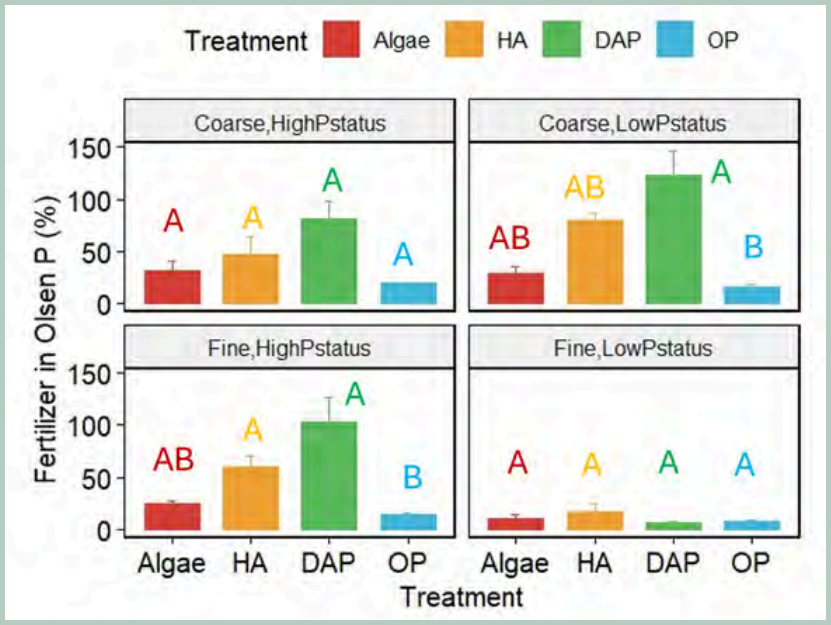

Fig. 3: Olsen P expressed as % of fertilizer applied

IMPLICATIONS FOR P FERTILIZER SELECTION

- Our results suggest synthetic fertilizers are more favorable for high P status soils but have limitations for low P status soils.
- In fine-textured low P status soils, algae shows promise for increasing P availability based on soil pore water results.
- P from bio-based fertilizers becomes plant available in 1-4 weeks, which should be considered for fertilizer application timing.
- Less than 5% of added P is found in soil pore water, and Olsen P recovery varies by soil type. Where does the rest of the fertilizer P go? To address this question we will next measure P in the microbial P pool.

- **Overall, our findings suggest choosing a fertilizer P source should be informed by the soil's P status and texture.**
- **Understanding where fertilizer P goes can help inform potential P availability later in the growing season and guide P management strategies.**

NEXT STEPS

- We will conduct a second incubation to focus on P availability from various organic fertilizers in low P soils
- 2 Soil types: coarse-textured low P status and fine-textured low P status
- 5 Fertilizer treatments: 3 algal strains, poultry manure pellet fertilizers of 2 brands, hydrolyzed fish-based liquid fertilizers, corn steep liquor derived powder fertilizers, & unamended control

ACKNOWLEDGEMENTS

Funding & Material Support: Cal State ARI, DOE, Grimm Family, & Braga Fresh

Research contributors: Sarah Milad, Miguel Ramos, Freddy Stacy, Cole Jones, Shelly Blackwell, Tryg Lundquist, Craig Stubler