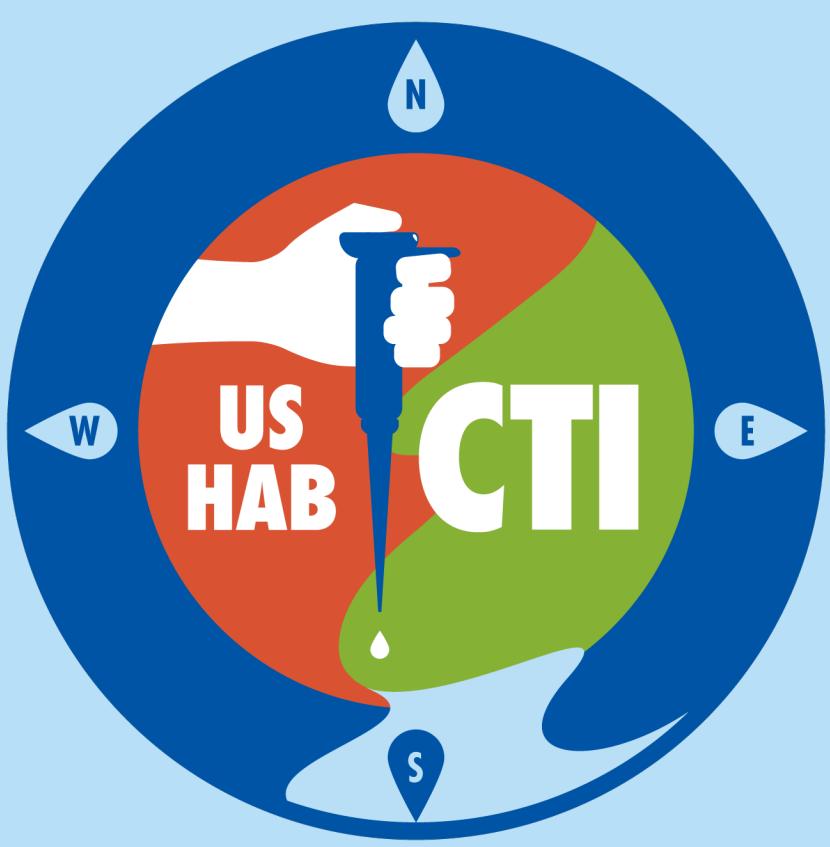




MIAMI



# Targeting *Microcystis* Blooms: Efficacy of PAC, CaO<sub>2</sub>, and Kaolinite in Algal Bloom Management



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## Introduction

### Cyanobacterial Blooms (CyanoHABS):

- Harmful cyanobacterial blooms, or CyanoHABS, reduce water clarity, suppress aquatic plants, and release toxins harmful to aquatic life (Paerl et al., 2013).

### Health Risks:

- These blooms produce toxins that can cause acute health issues in mammals, including humans, affecting various systems such as the digestive and nervous systems (Carmichael et al., 2012).
- The decay of these blooms can also deplete oxygen levels, leading to fish kills (Paerl et al., 2013).

### Climate Change Impact:

- The occurrence and severity of CyanoHABS are increasing due to climate change factors like elevated temperatures and eutrophication (Shahmohamadloo et al., 2019).

### Mitigation Techniques:

- Flocculation and sedimentation strategies are employed to aggregate and remove harmful algae from water. This technique can be enhanced with algaecides to combat toxic cyanobacteria (Gallardo-Rodríguez et al., 2019; Arruda et al., 2021).



Image. 1. Massive *Microcystis* bloom (3 August 2019) near the mouth of the Maumee River (Ohio).

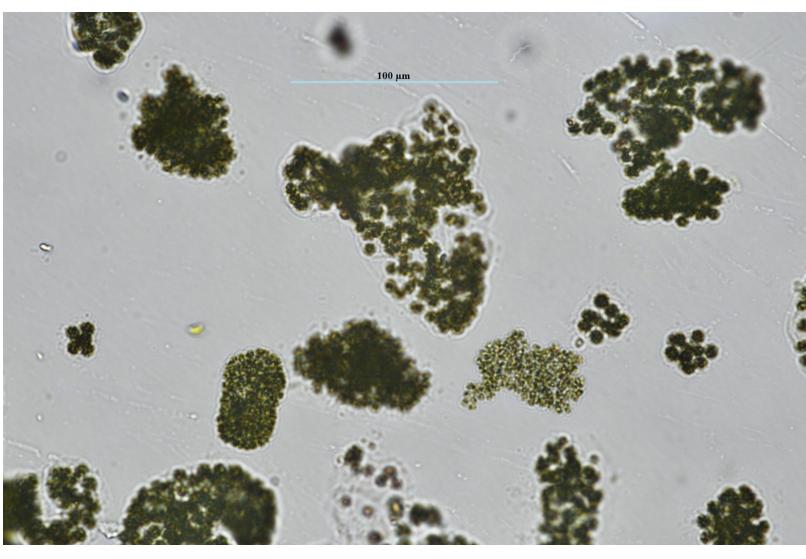


Image. 2. *Microcystis* colonies often found floating on water surface.

## Hypothesis/Objective

### Hypothesis

- The combination of Calcium peroxide (CaO<sub>2</sub>), Poly aluminum chloride (PAC), and kaolinite will effectively create flocculation and sedimentation, targeting and negatively impacting the photophysiology of *Microcystis* and its toxins (microcystins).

### Objective

- Measure the efficiency of CaO<sub>2</sub>, PAC, and kaolinite in targeting cultured *Microcystis* and its toxins (microcystins).
- The focus is on discovering environmentally sound mitigation techniques against HABs species.

## Methods

### Preliminary Experiments

- Initial exposure experiments were conducted using varying CaO<sub>2</sub> concentrations (1 mg/L, 5 mg/L, and 10 mg/L) on *Microcystis* culture (500,000 cells/mL) in 50 mL tubes to determine the most efficient concentration for eliminating *Microcystis*.
- CaO<sub>2</sub> + PAC + Kaolinite Trials**
- Exposure experiments were performed using different combinations of CaO<sub>2</sub> (5 mg/L), PAC (50 mg/L), and kaolinite (50 mg/L) with *Microcystis* culture (500,000 cells/mL) in 50 mL tubes to determine the best combinations for flocculation and sedimentation of *Microcystis*.
- Upscaled tests were conducted with CaO<sub>2</sub> (10 mg/L), PAC (100 mg/L), and kaolinite (100 mg/L) with *Microcystis* culture (1,000,000 cells/mL) in 125 mL flasks to determine the best combinations for flocculation and sedimentation of *Microcystis*. Toxin analyses were performed to detect microcystins.

### Analysis

- TD-700 Fluorometer** was used to determine the abundance of cells in samples by measuring fluorescence emitted by *Microcystis*.
- PAM fluorometry** was used to determine the photophysiology of *Microcystis* by measuring the fluorescence emitted by chlorophyll molecules in the photosystems of the algae.
- Enzyme-Linked Immunosorbent Assay (ELISA)** was used for detecting and quantifying microcystin in samples.

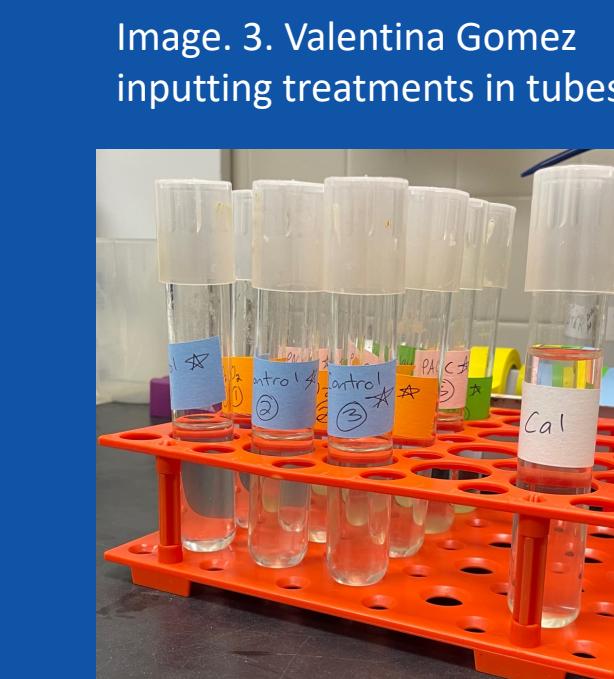


Image. 3. Valentina Gomez inputting treatments in tubes.  
Image. 4. 50 mL tubes used for exposure experiments.



Image. 5. 125 mL flasks used for exposure experiments, treatments after 72 hours of incubation.

## Results

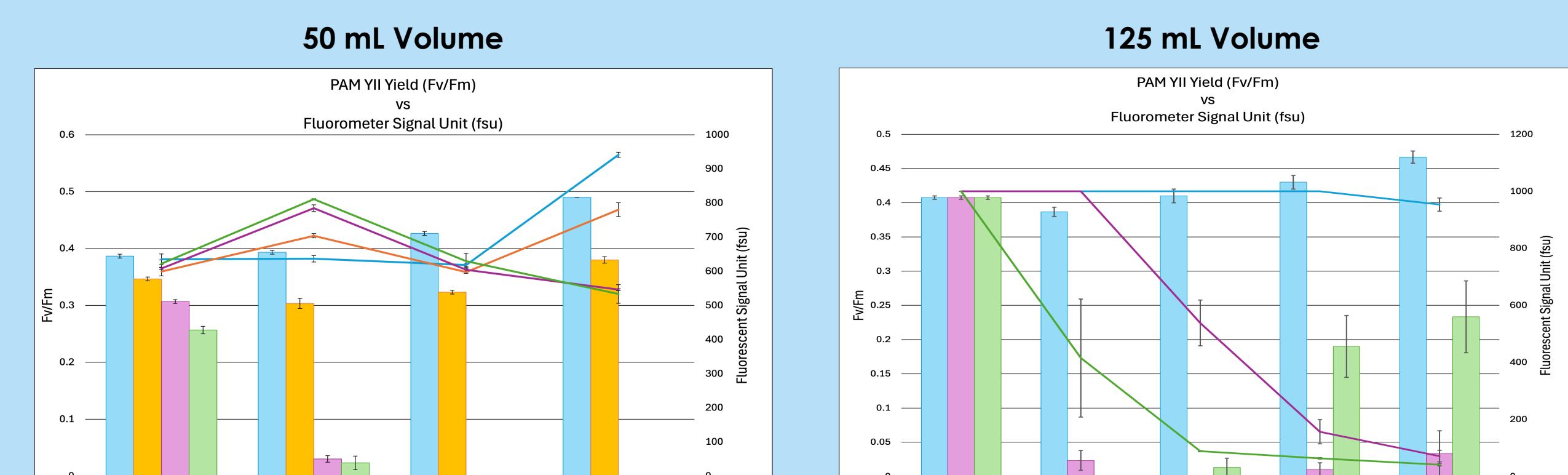


Fig. 1. PAM YII Yield (Fv/Fm) and Fluorescent signal units (fsu) of cyanobacteria suspensions incubated for 48 hours with different concentrations of the algicide CaO<sub>2</sub>. Error bars for PAM YII Yield represents the standard error of triplicate samples, and error bars for fsu represents standard deviation of triplicate samples.

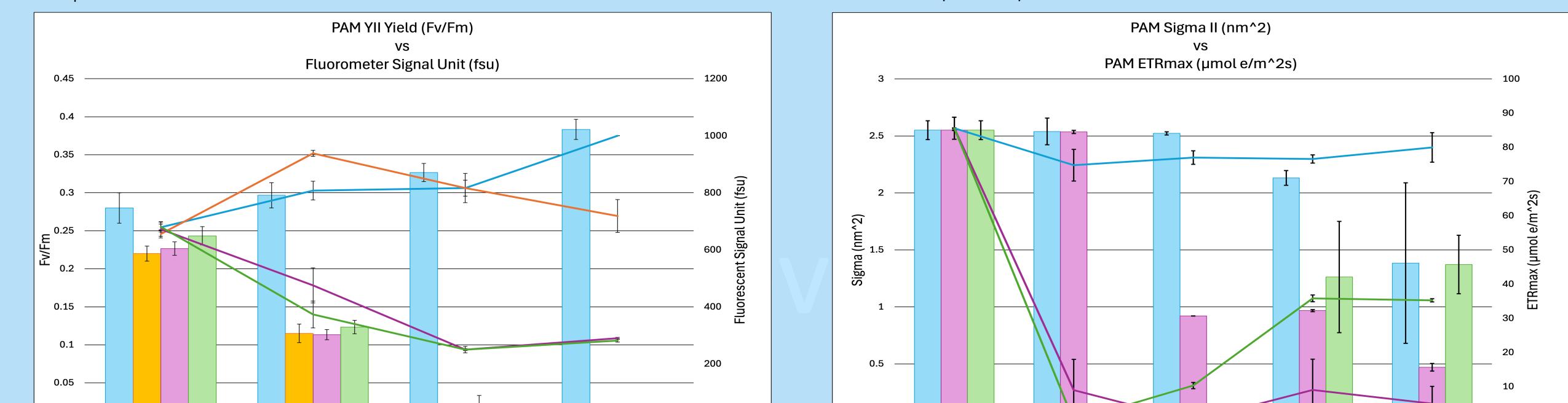


Fig. 2. PAM YII Yield (Fv/Fm) and Fluorescent signal units (fsu) of cyanobacteria suspensions incubated for 48 hours with different concentrations of the algicide and flocculants, CaO<sub>2</sub>, PAC, and clay. Error bars for PAM YII Yield represents the standard error of triplicate samples, and error bars for fsu represents standard deviation of triplicate samples.

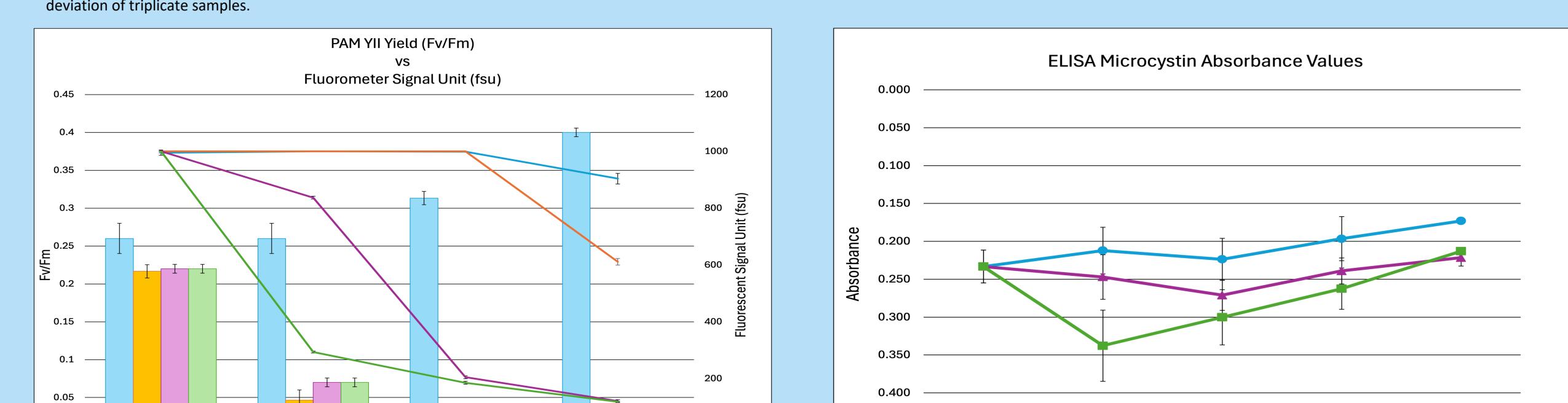


Fig. 3. PAM YII Yield (Fv/Fm) and Fluorescent signal units (fsu) of cyanobacteria suspensions incubated for 48 hours with different concentrations of the algicide and flocculants, CaO<sub>2</sub>, PAC, and clay. Error bars for PAM YII Yield represents the standard error of triplicate samples, and error bars for fsu represents standard deviation of triplicate samples.

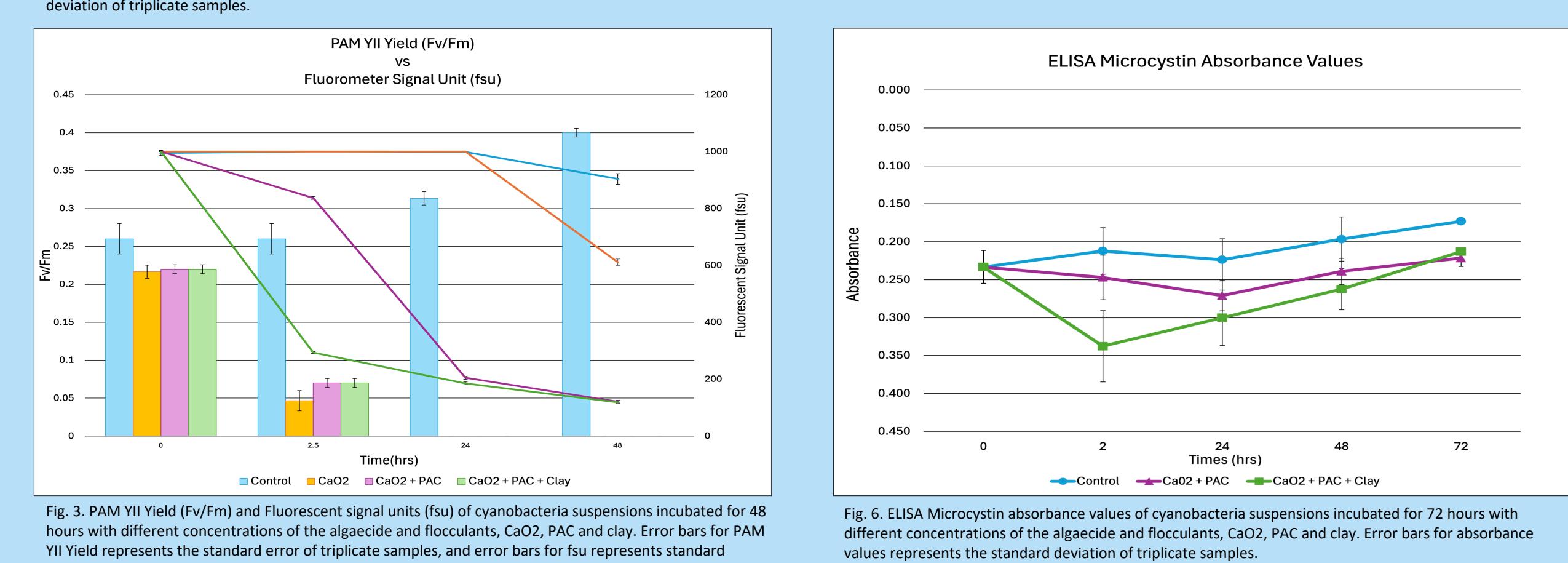


Fig. 4. ELISA Microcystin Absorbance Values of cyanobacteria suspensions incubated for 72 hours with different concentrations of the algicide and flocculants, CaO<sub>2</sub>, PAC and clay. Error bars for absorbance values represents the standard deviation of triplicate samples.

## Conclusions

- CaO<sub>2</sub> works as an efficient algaecide and ballast against *Microcystis*, but does not effectively target the toxin microcystin.
- Larger amounts of components are needed to affect larger amounts of biomass.
  - In these tests, it seems for every 100,000 cells/mL, 1 mg/L of CaO<sub>2</sub> can be used to kill *Microcystis*.
- CaO<sub>2</sub> + PAC has similar floc and sink properties to CaO<sub>2</sub> + PAC + Clay in targeting *Microcystis*.
- In higher volumes, the floc and sink properties do not work as efficiently.

### Future Direction

- Find the most cost-effective proportions for components to efficiently floc and sink *Microcystis* at higher volumes.
- Determine the effects components have on other organisms found in the water column.
- Compare reactions to components with cultured and field-collected *Microcystis*.

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