Several kinds of algal-based ecotechnologies are being studied for removing nutrients and sediments from polluted water bodies. These include Algal Turf Scrubbers (ATS), which are engineered water treatment systems that remove nutrients from a water source via algal production. ATS systems have simple designs which can be much less costly than other methods of treatment. For an ATS to perform efficiently, the growing algae must periodically be harvested from the system. ATS biomass could be used as a fertilizer substitute when considering the environmental implications of commercial fertilizer and the high costs of eco-technology to remove excess nutrients from bodies of water. ATS biomass as a soil amendment provides an equal amount of nutrients to seedlings as commercial fertilizer and the high costs of eco-technology to clean water bodies. Further experiments with longer time periods could be done to explore plant and/or fruit quality compared to commercially grown fertilizers.

Methods

- **Experiment 1:** fertilizer application in triplicate for each treatment in 6 inch pots with 80 grams of potting soil.
  - Treatment 1 & 2: contained commercial fertilizer “high” and “low” Espoma Garden-Tone 4-6-6.
  - Treatments 3, 4, & 5: Equal nutrient amounts of ground freshwater algae (<0.5 ppt of salt) from the Susquehanna River were added in “high” “medium” and “low”.
  - Treatment 6: A control with no added nutrients was tested.

- **Experiment 2:** same as above, but algae treatment with brackish water algae (8.0-12.0 ppt of salt) from the Port of Baltimore. Five treatments, with only “low” and “high” algae amendment added.

The plant used in the experiment was cucumber (Cucumis sativus), which has a maturity of approximately 50-70 days. Over this period, the cucumbers were grown indoors in the Animal Science Building at the University of Maryland. The cucumber was kept at room temperature, under LED plant grow lights. During the both trials, five seeds were planted 1 inch deep and 1.5 inches from the center of each pot to ensure germination. After about 4 weeks of the first trial, the cucumbers were harvested and plant height and mass were measured for analysis.

<table>
<thead>
<tr>
<th>Nutrients added (g)</th>
<th>Control</th>
<th>Fertilizer Low</th>
<th>Fertilizer High</th>
<th>Algae Low</th>
<th>Algae Medium</th>
<th>Algae High</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total 1</strong></td>
<td>0.0</td>
<td>1.7</td>
<td>3.3</td>
<td>6.3</td>
<td>12.4</td>
<td>24.0</td>
</tr>
<tr>
<td><strong>Total 2</strong></td>
<td>0.0</td>
<td>1.7</td>
<td>3.3</td>
<td>9.8</td>
<td>-</td>
<td>23.1</td>
</tr>
</tbody>
</table>

### Results

- **Algal plant biomass:**
  - High fertilizer plant group: 0.07g. Low fertilizer group: 0.09g.
  - Low algae plant group: 0.09g. Medium algae plant group: 0.19g. High algae plant group: 0.36g.
  - A t-test run on the algae high and fertilizer high groups resulted in a p-value of 0.092, which supported the null hypothesis of no difference in plant growth between algae and commercial fertilizers.
  - A t-test for the low algae and low fertilizer groups resulted in a p-value of 0.060, which also supported the null hypothesis.

### Discussion

- Our results show that the ATS biomass as a soil amendment provides an equal amount of nutrients to seedlings as commercial fertilizer when growing plants in potted soil.
- The two nutrient sources increased plant yield at about the same rate.
- These results suggest that ATS biomass could be used as a fertilizer substitute when considering the environmental implications of commercial fertilizer and the high costs of eco-technology to remove excess nutrients from bodies of water.
- Other factors: which ATS biomass (brackish vs. freshwater)? At what scale?
- Although our experiment took place in a small-scale laboratory setting, the results suggest the potential use of ATS biomass in larger scale agricultural systems, thus closing the open fertilizer system and reducing the need for excess nutrients in fertilizers, while simultaneously saving money on highly expensive eco-technologies to clean water bodies.

### References


### Figures

- Figure 1: Cucumber seedlings growing in grow chamber under LED lights.
- Figure 2: Cucumber seeds are separated via size by treatment for percent germination.
- Figure 3: Cucumber plants from Trial 1 ordered by treatment before cutting, drying, and weighing at week 4. Treatments from left to right in triplicate: Control, Algae high, Algae medium, Algae low, Fertilizer low, Fertilizer high.
- Figure 4: Average dry biomass of cucumber plants (dry weight per pot frame) with various treatments.