

Compost Nutrient Optimization Using Algal Biomass Amendment

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Introduction

Wastewater treatment plants worldwide are a necessary and important function of society. Central Valley Water Reclamation Facility (CVWRF) in Utah is a facility where contaminated water from sewer systems is brought in, filtered, purified, and released back into rivers and lakes in enormous quantities. The biosolids removed during the many filtration steps are digested anaerobically to produce bio-methane, and then composted with woodchips to be sold as a soil amendment, capable of supplying nitrogen, phosphorus, potassium, and other nutrients to plants for agricultural use. Although a valuable product, analysis of this compost has shown that the nutrient content is low compared to commercial fertilizers. This experiment will show that the addition of an algal biomass grown on a reclamation facility waste stream can be included in the compost to increase concentration of nitrogen, phosphorus, and potassium available to plants while decreasing the toxic concentrations found in the wastewater.

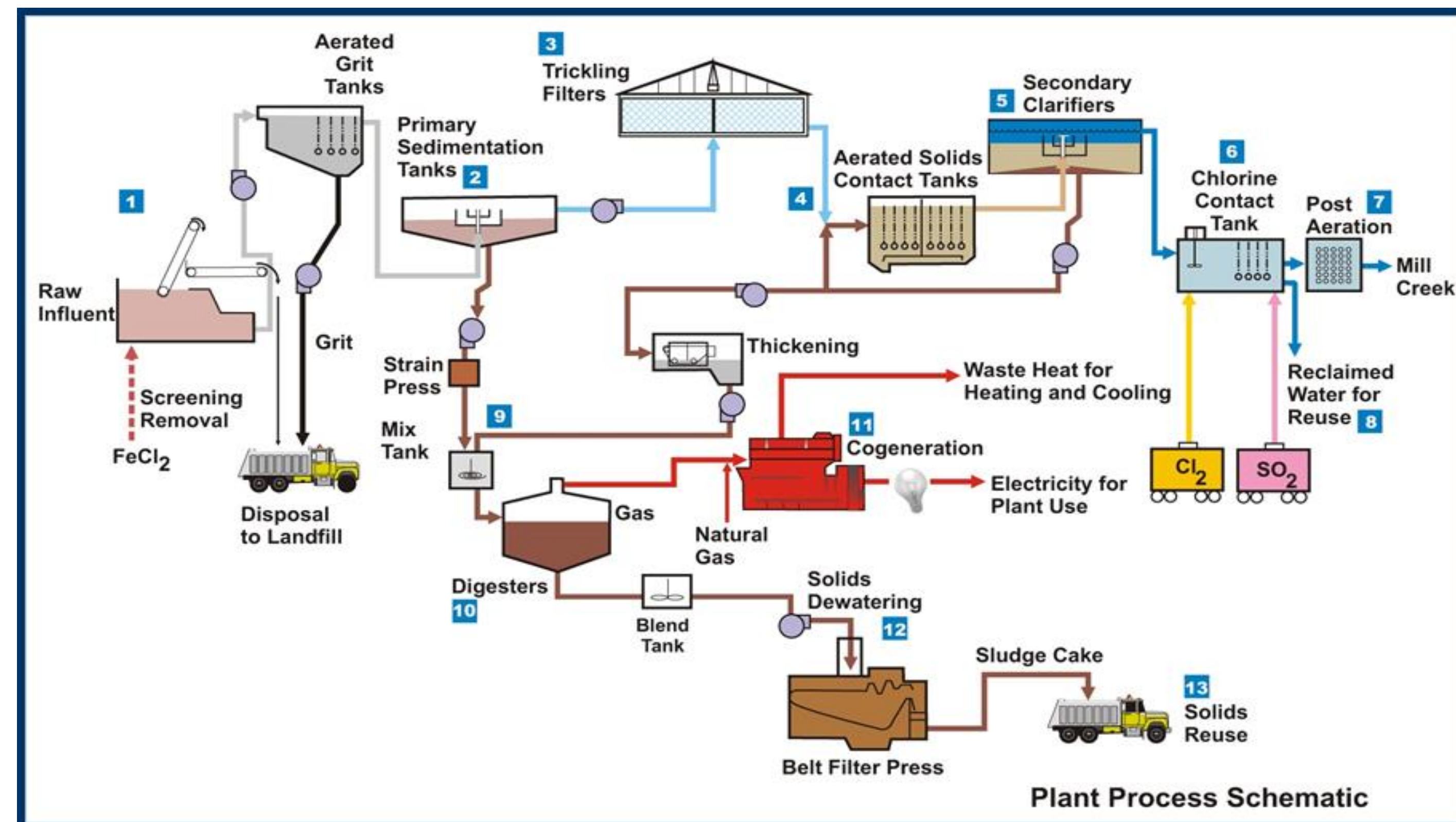
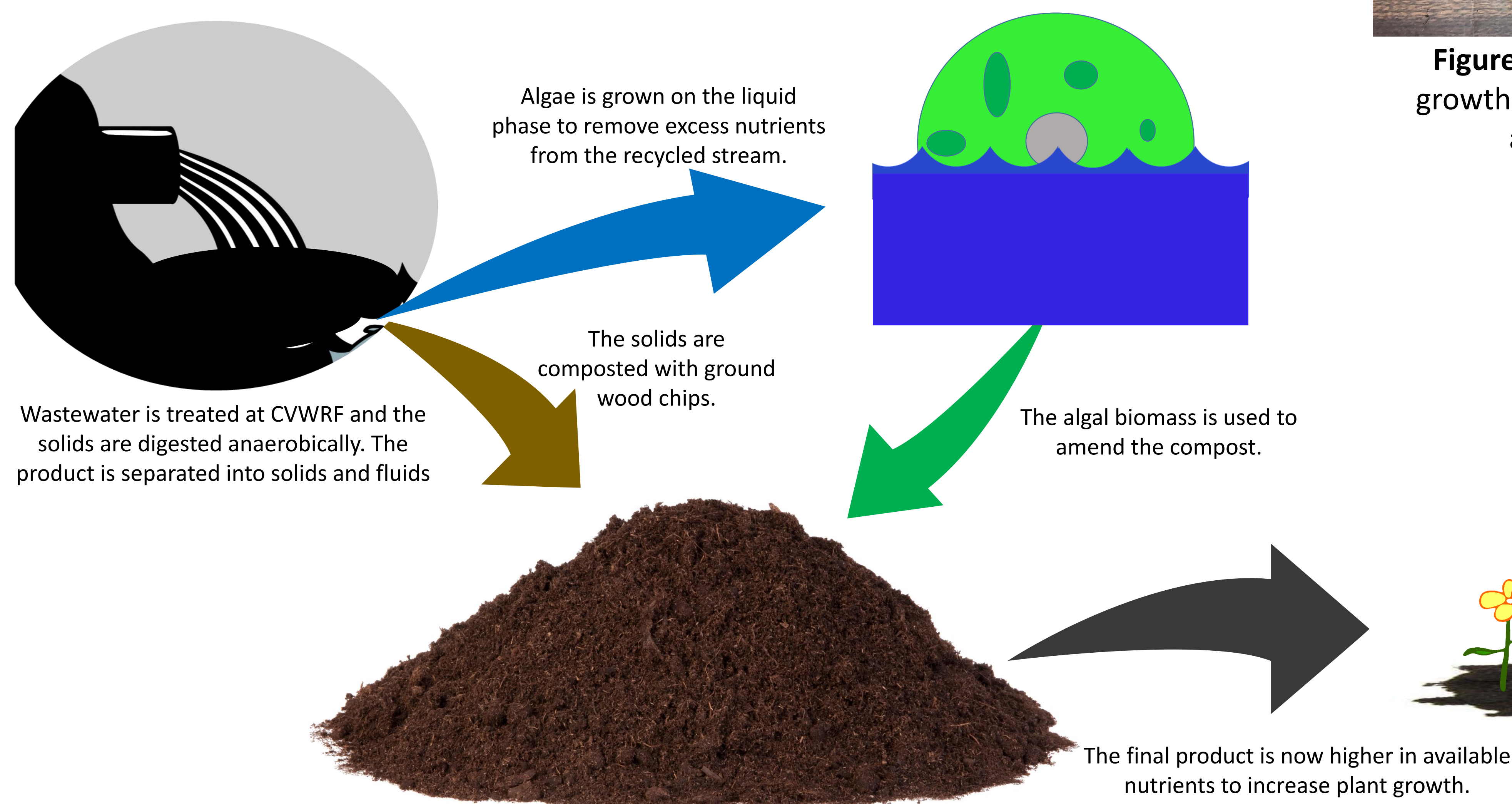


Figure 1. Central Valley Water Reclamation Facility Processes.

Methods

The digested bio-solids from municipal wastewater at CVWRF are press-separated to produce biosolids and water containing toxic nutrient concentrations. These biosolids are mixed with ground woodchips and composted for 8 weeks to produce a value-product which is then sold to businesses and the public. This study uses algae grown on that waste-stream to reduce the toxic nutrient levels and integrates it into the composting process to raise available nutrients in the final mature compost. Various ratios of algae to compost mixtures were used to grow Romaine lettuce in order to determine if the algae-amended compost supplies more available nutrients to the plant, thus improving plant health and growth. The treatments were: Pure seedling mix (PS), Mature Compost only (MC), and Mature Compost mixed with algae at two different ratios (8:2, 9:1). Each treatment was applied at 75% seedling mix, 25% treatment.



Results and Discussion

At the end of the trial, the lettuce plants were analyzed to determine their height, maximum leaf width, number of leaves, wet mass and dry mass. The results of the analysis can be found in Figures 2 and 3. The data indicates that the mature compost soil amendment promoted the most growth in the lettuce, while the algae-amended mixture only slightly hindered the growth. This is likely due to the addition of algae after the composting process. The algae was not degraded nor killed, and thus the nutrients were not fully available to the lettuce plants, and the algae may have begun to grow and compete with the plants. The algae used for this experiment was analyzed for nitrogen content, and it was determined that the algae when fully degraded supplies a 13.86% increase in nitrogen content to the compost at a 8:2 wet compost mass to wet algal mass ratio.

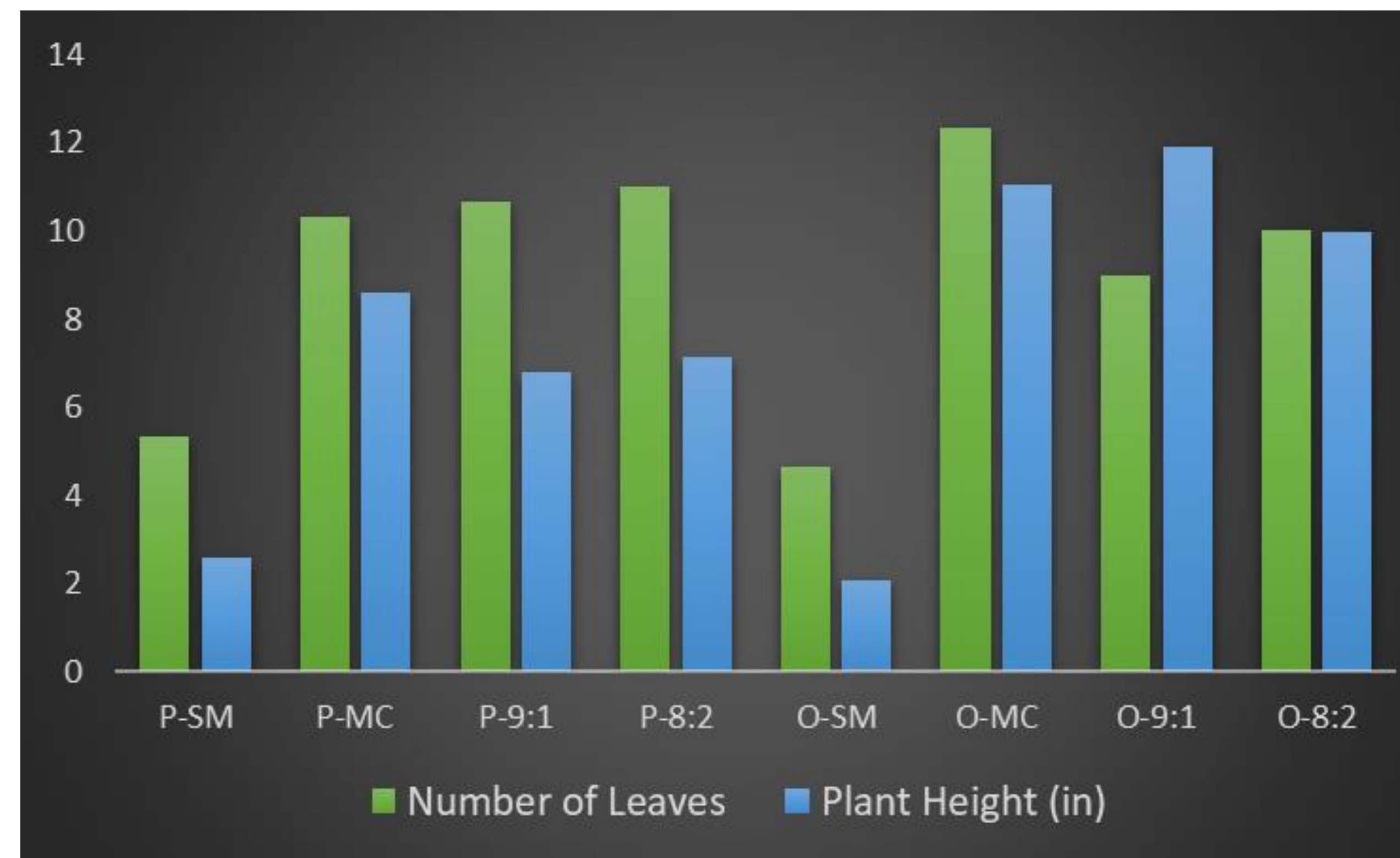


Figure 2. The correlation between plant height in inches and number of leaves.

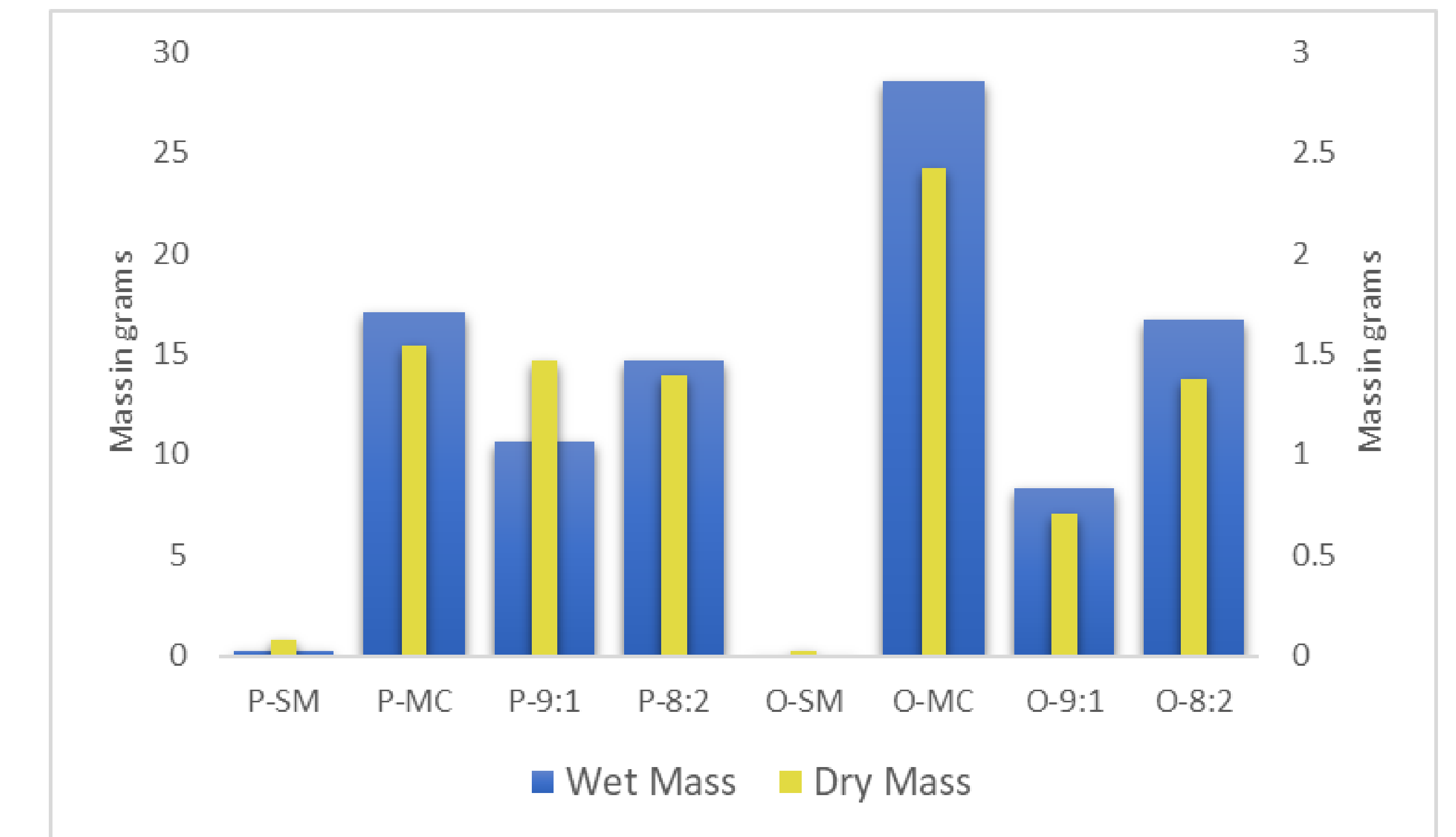


Figure 3. The average wet mass and dry mass of each trial.

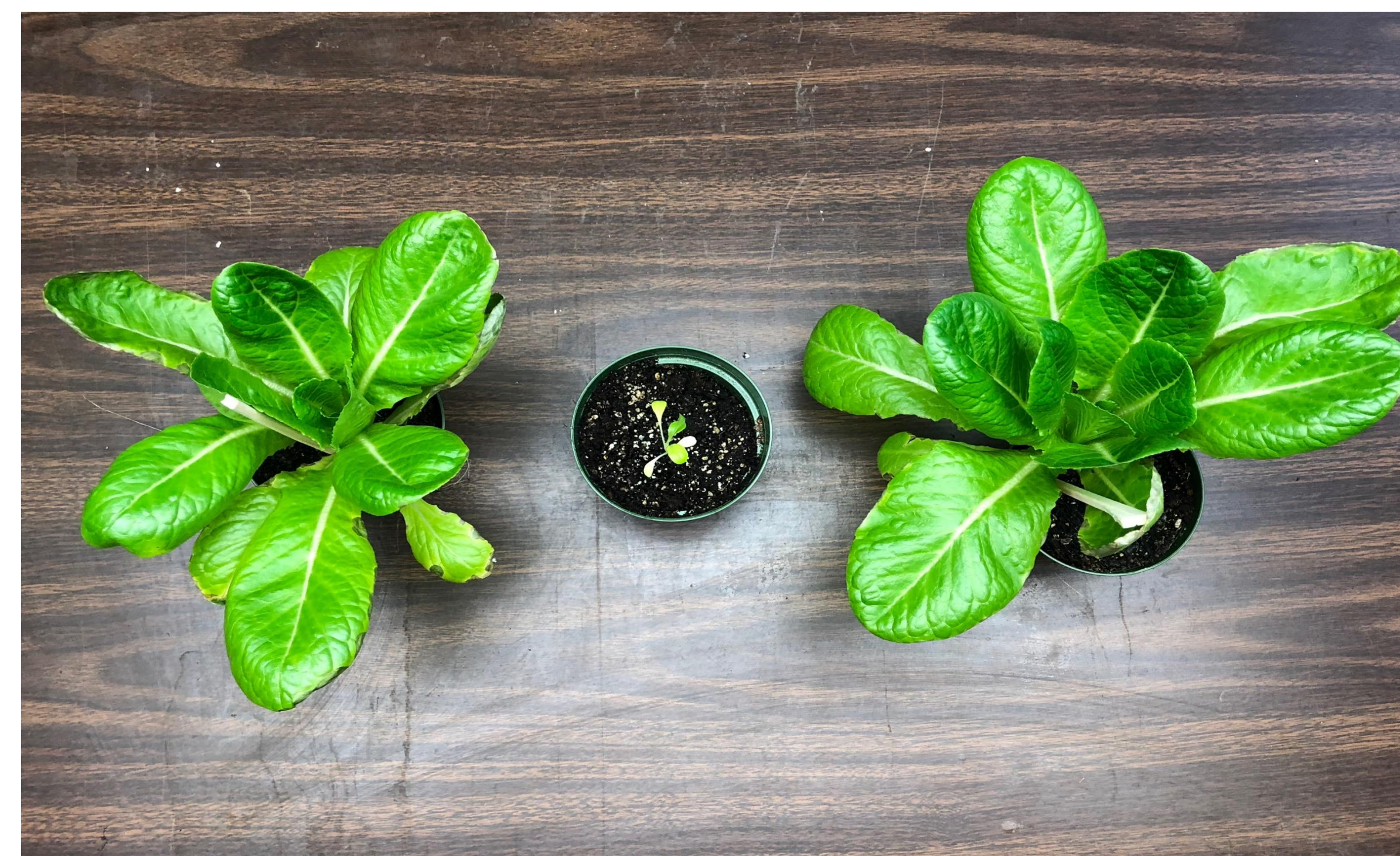


Figure 4. A comparison of three lettuce plants after 6 weeks of growth. The soil treatments used are left to right: 8:2 compost to algae mix, pure seedling mix, and mature compost.

Table 5: Theoretical Nutrient Addition from Algal Biomass.

Material	Percent N (dry basis)	grams N (1kg dry basis)	Percent Increase (1 kg 8:2 wet basis)
Mature Compost	2.30%	23	-
Algal Biomass	8.69%	86.9	13.86%

Conclusions and Future Work

The algal amendment hinders plant growth when not degraded fully. When the algae is submitted to the composting process, the nitrogen content should increase by 13.86%, and increase plant growth. This will create a more valuable product for wastewater treatment facilities.

Future work includes a plant growth trial using an algae-compost mixture that has been submitted to the entire composting process.

Acknowledgements

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