

### INTRODUCTION

#### Wastewater

Wastewater is the liquid or water-carried waste accrued from sanitary operations. This waste contains toxins that must be purified, as it poses an obvious environmental and public health hazard. This risk is significantly higher in developing countries (Ullah et al., 2021).

#### Duckweed

A member of the Lemnaceae family, this free-floating aquatic plant claims low maintenance, fast growth rate, and efficient waste removal, which makes it ideal for wastewater treatment in developing countries (Zirschky and Reed, 1988). Typically, *Lemna minor* is used at most wastewater facilities, but there are over 37 species of duckweed (Ozengin and Elmaci, 2007).



*Lemna minor*

### QUESTION

Is there a better species of duckweed for wastewater management than *Lemna minor*?

### MATERIALS AND METHODS

#### Strains



*Lemna minuta*



*Lemna minor*



*Spirodela polyrhiza*

#### Trials

##### Trial 1

- Constant Nutrients
- 8-week growth period
- 15-16°C

##### Trial 2

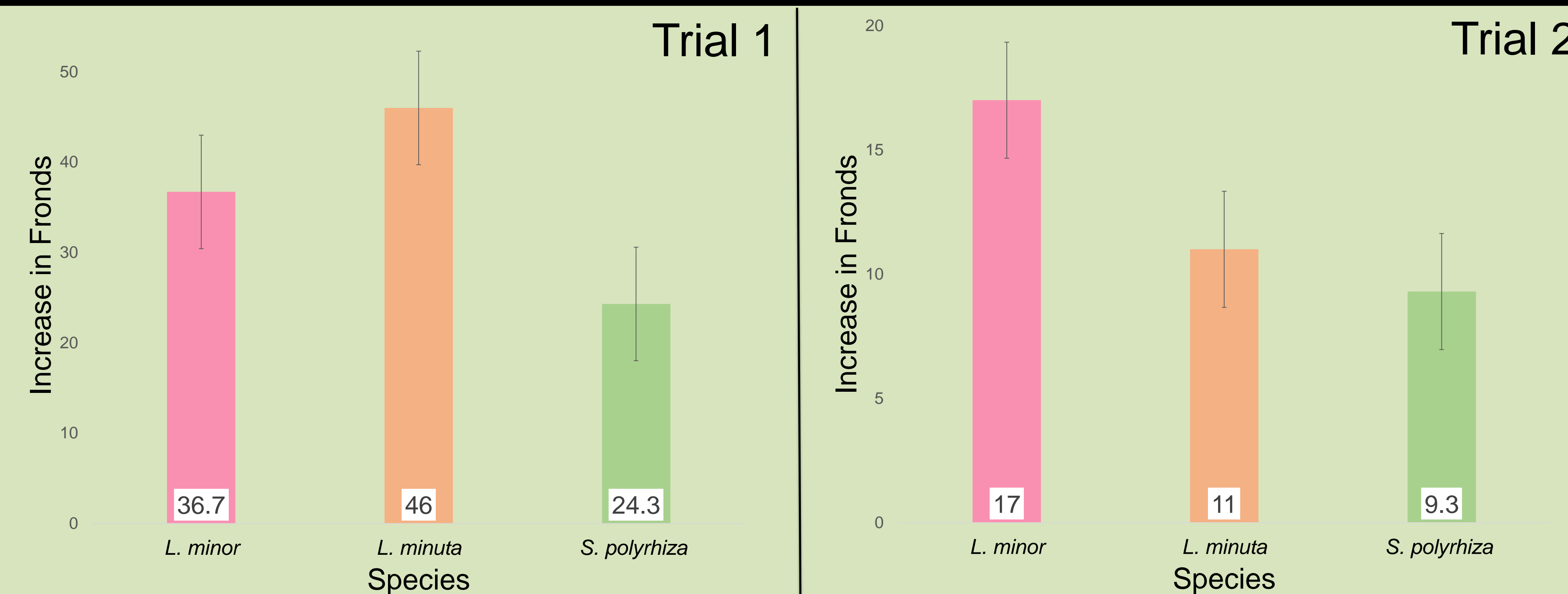
- Constant Nutrients
- 3-week growth period
- 15-16°C

##### Trial 3

- Variable Nutrients
- 11-day growth period
- 15-16°C

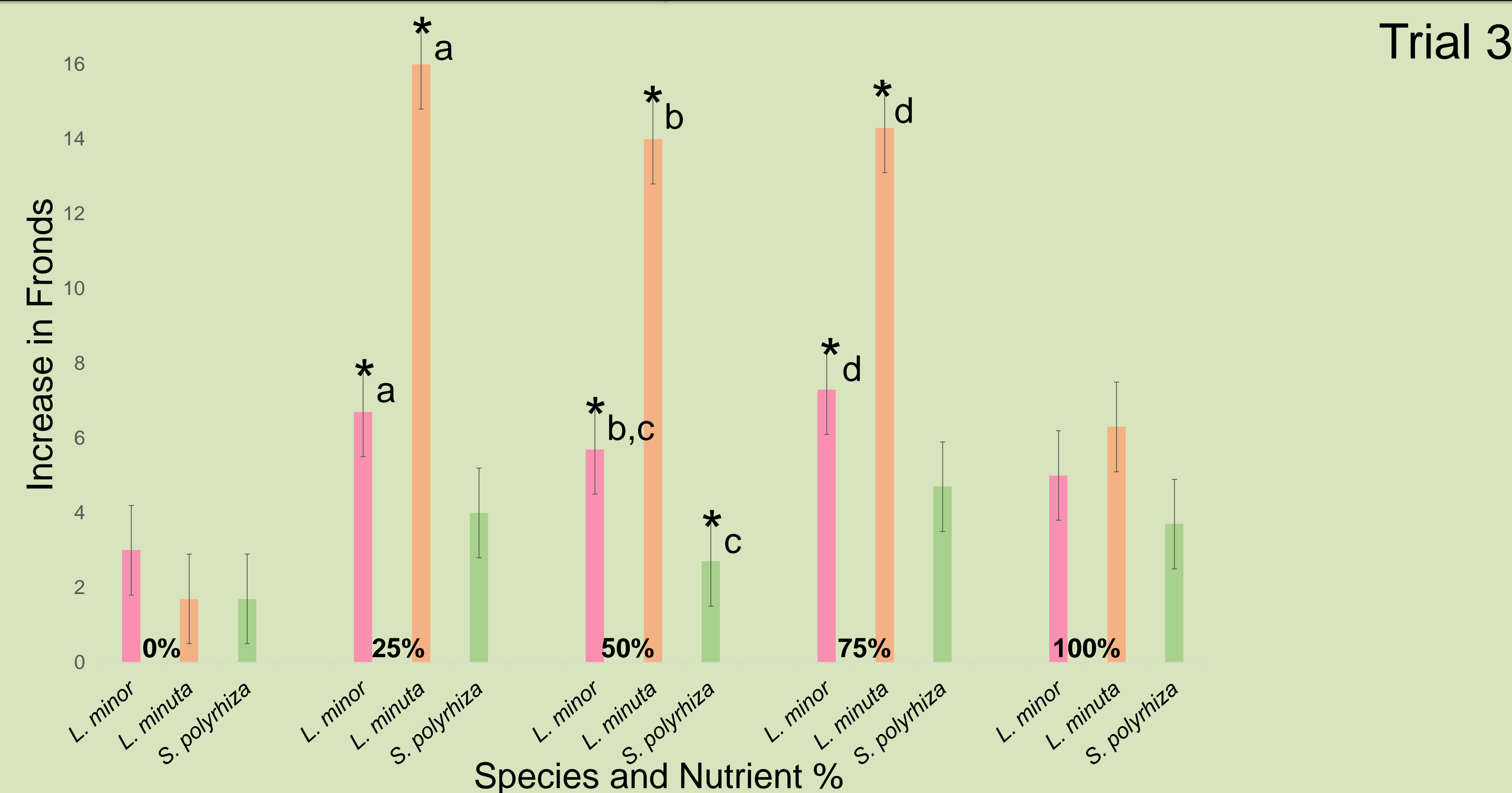
- Conviron A1000 Growth Chamber
- Hoagland's Solution
- Measured frond increase and chlorophyll concentration

### RESULTS

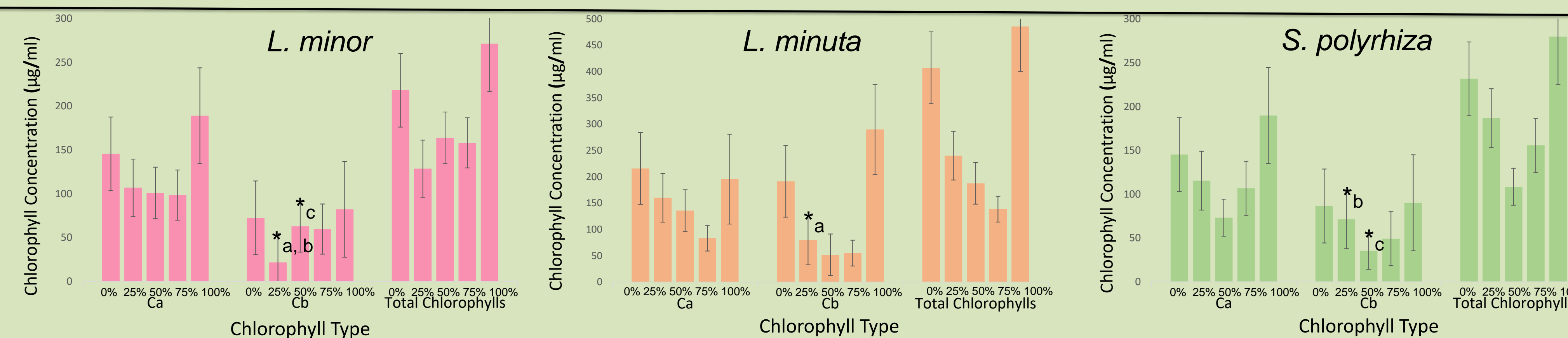


**Figure 1.** Average increase in fronds of three duckweed species grown over eight weeks. No significant difference between *L. minor* and *L. minuta* or between *L. minor* and *S. polyrhiza* was observed ( $P > 0.05$ ).

**Figure 2.** Average increase in fronds of three duckweed species grown over three weeks. No significant difference between *L. minor* and *L. minuta* or between *L. minor* and *S. polyrhiza* was observed ( $P > 0.05$ ).



**Figure 3.** Average increase in fronds of three duckweed species with varying nutrient availability over an eleven-day period. 0% resulted in no significant difference between *L. minor* and *L. minuta* or between *L. minor* and *S. polyrhiza* ( $P > 0.05$ ). 25% resulted in a significant increase between *L. minor* and *L. minuta* ( $P < 0.05$ ). 50% resulted in a significant increase between *L. minor* and *L. minuta* ( $P < 0.05$ ) and a significantly smaller number of fronds between *L. minor* and *S. polyrhiza* ( $P < 0.05$ ). 75% resulted in a significant increase between *L. minor* and *L. minuta* ( $P < 0.05$ ). 100% resulted in no significant difference between *L. minor* and *L. minuta* or between *L. minor* and *S. polyrhiza* ( $P > 0.05$ ).



**Figure 4.** Average chlorophyll concentration of three duckweed species with varying nutrient availability after an 11-day growth period. 0% resulted in no significant difference between *L. minor* and *L. minuta* or between *L. minor* and *S. polyrhiza* ( $P > 0.05$ ). 25% resulted in a significantly higher concentration of chlorophyll b between *L. minor* and *L. minuta* and between *L. minuta* and *S. polyrhiza* ( $P < 0.05$ ). 50% resulted in a significantly lower concentration of chlorophyll b between *L. minor* and *S. polyrhiza* ( $P < 0.05$ ). 75% resulted in no significant difference between *L. minor* and *L. minuta* or between *L. minor* and *S. polyrhiza* ( $P > 0.05$ ). 100% resulted in no significant difference between *L. minor* and *L. minuta* or between *L. minor* and *S. polyrhiza* ( $P > 0.05$ ).

### DISCUSSION

Is there a better species of duckweed than *Lemna minor* for wastewater management?

**No!**

*Lemna minor* remains the preferred species for wastewater management.

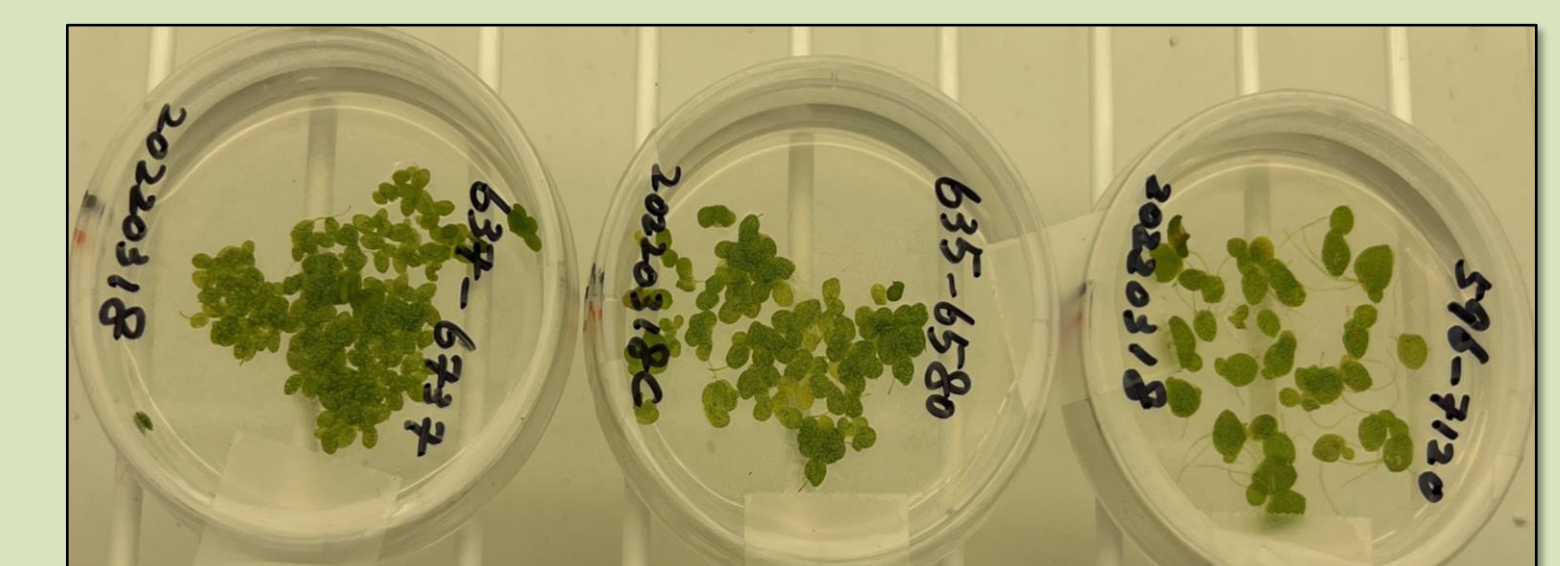
After three weeks, growth increases more exponentially. *Lemna minuta* produces smaller fronds at a faster rate than *Lemna minor* but does not hold more chlorophyll. It only produced more chlorophyll b at 25%. *Spirodela polyrhiza* is not a good species for wastewater management. This species grows at a slower rate, produces less fronds, is more sensitive to temperature change, and holds less chlorophyll than *Lemna minor*.



Species in Hoagland's

### FUTURE RESEARCH

- Use other species
- Warmer temperature range
- Include leaf area in calculations



Species in Agar

### ACKNOWLEDGEMENTS

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### REFERENCES

- Ozengin, N., Elmaci, A. 2007. Performance of duckweed (*Lemna minor* L.) on different types of wastewater treatment. *J Environ Biol.* 28(2):307-14.
- Zirschky, J., Reed, S. C. 1988. The use of duckweed for wastewater treatment. *J Water Pollution Control Federation.* 60(7):1253-8.
- Ullah, H., Gul, B., Khan, H., Zeb, U. 2021. Effect of salt stress on proximate composition of duckweed (*Lemna minor* L.). *Heliyon.* 7(6):e07399.