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Effect of Carbon Supplementation on Denitrifying Bacteria in Woodchip Bioreactors

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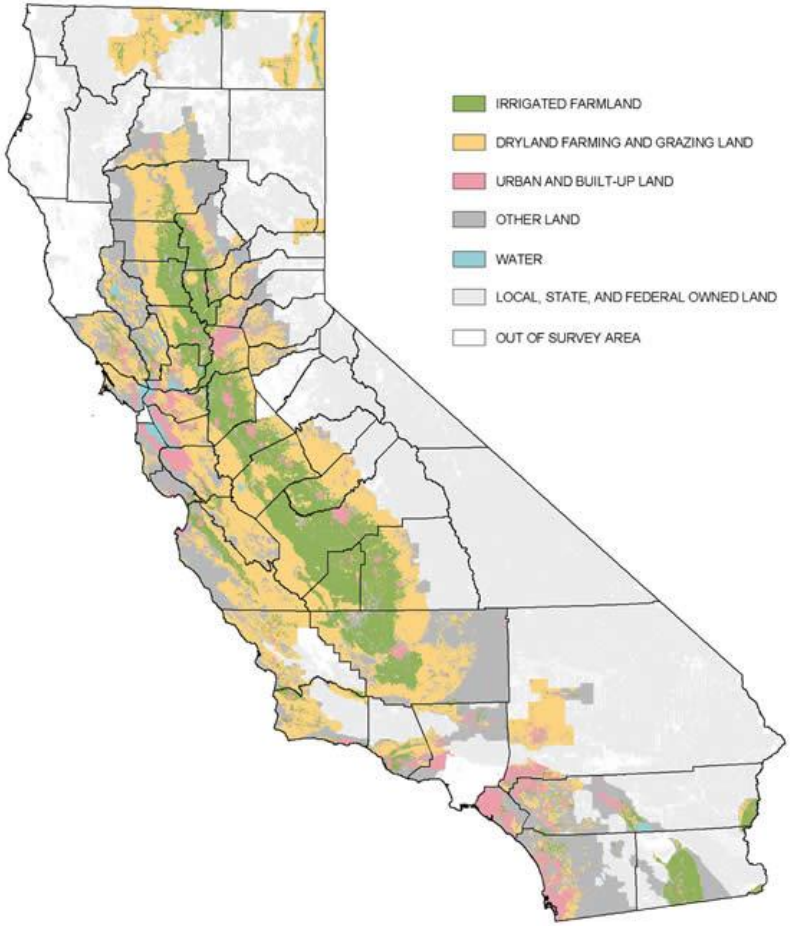
Agriculture Runoff Treatment

Important Farmland in California



http://162.242.222.244/programs/states/futureisnow/default.asp

Nutrient Application and Runoff

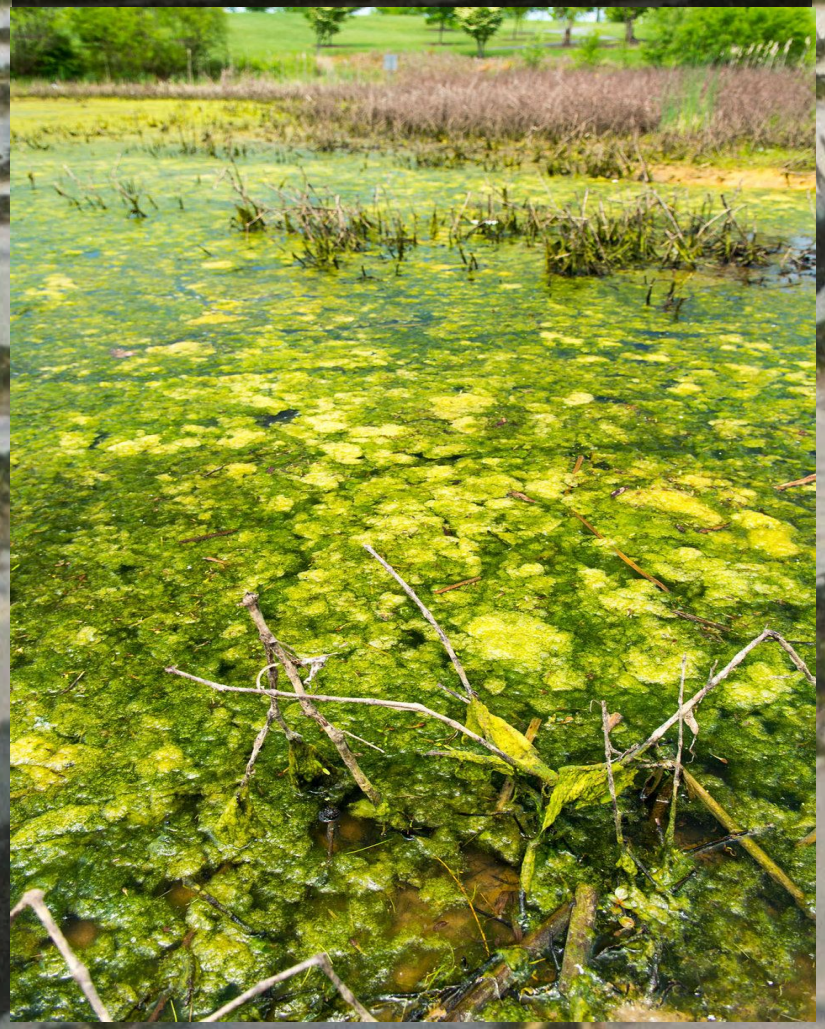
https://seaotters.com

Environmental Impacts and Human Health

http://www.wri.org

Impacts of Nitrate Pollution

Eutrophication and Algal Blooms

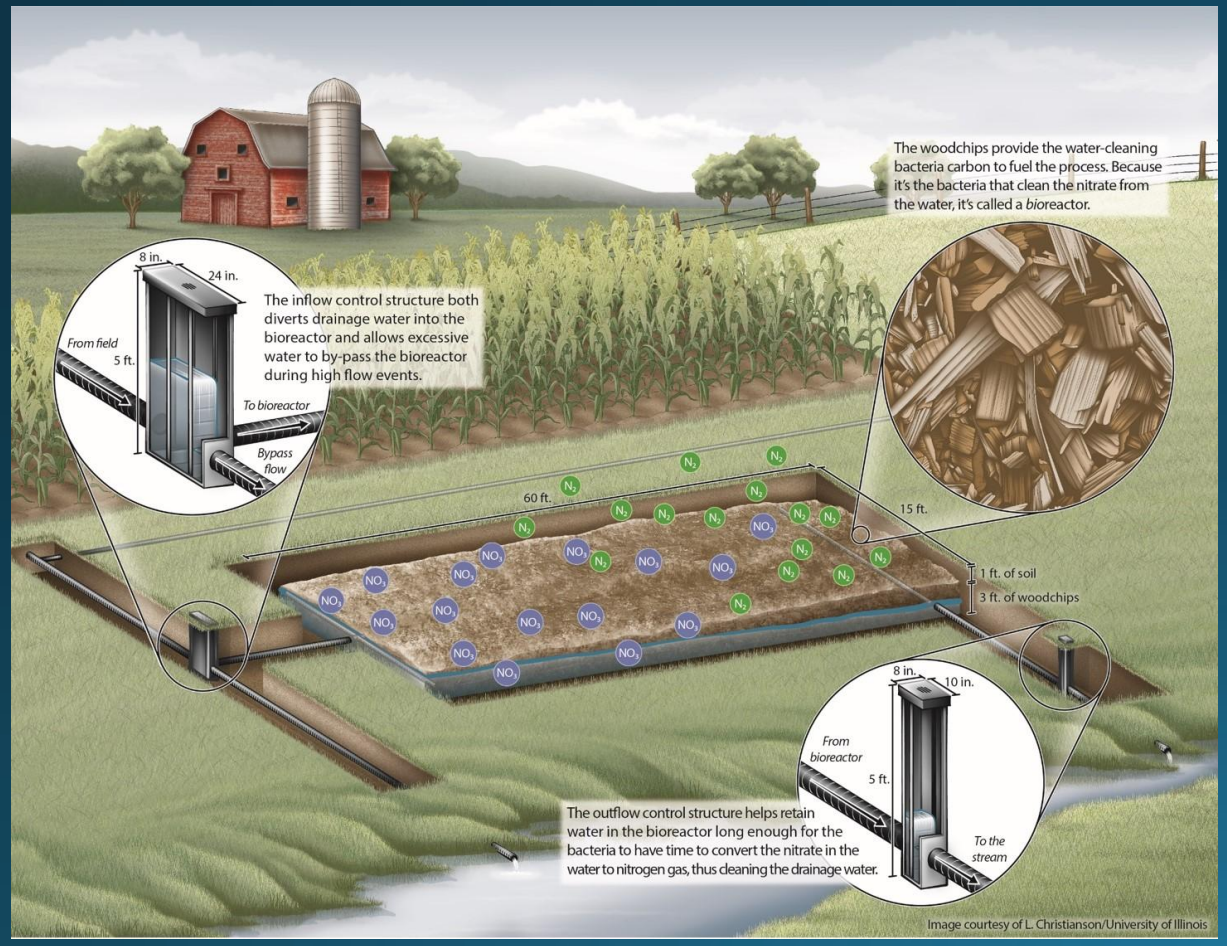


Human Diseases and Illnesses

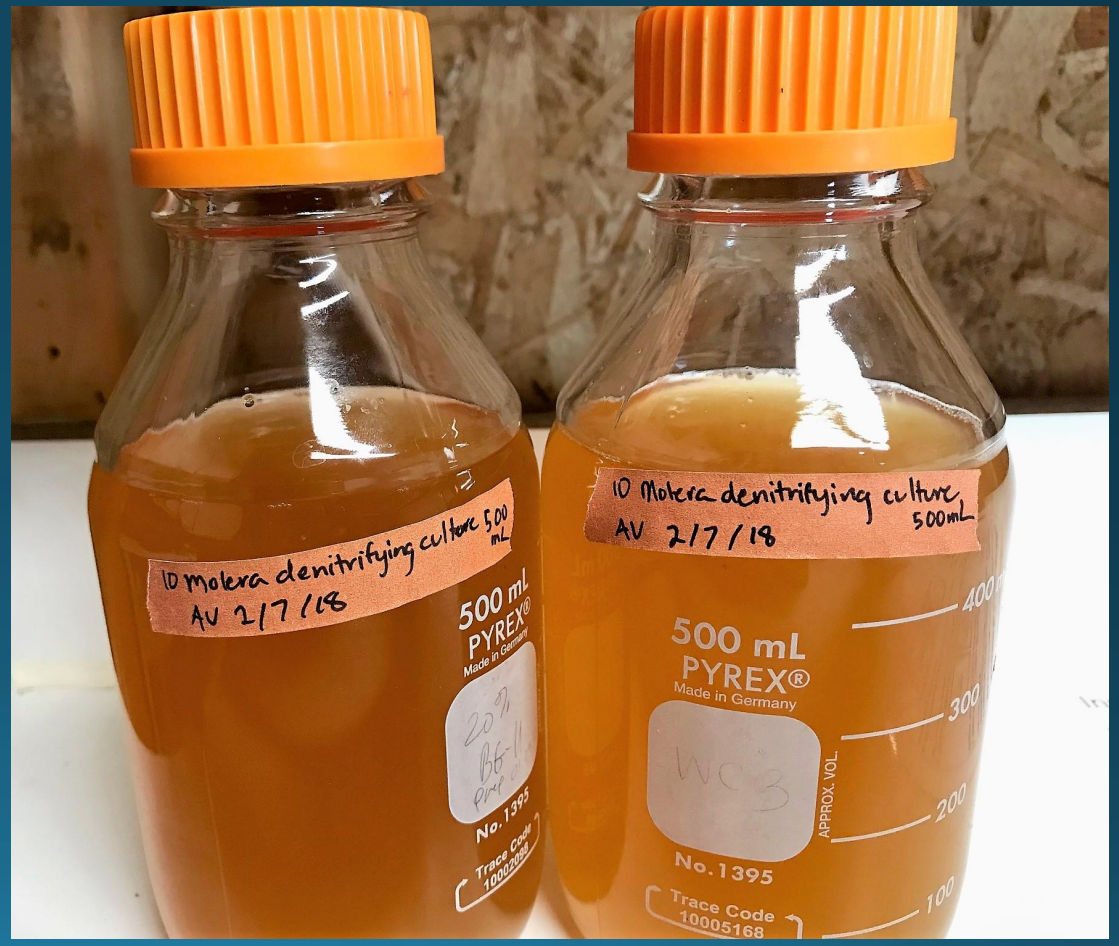
Loss of Water Ecosystem Services

Bioremediation of Agricultural Runoff Using Bacterial Communities in Woodchip Bioreactors

Wood chip bioreactors provide a viable substrate and carbon.



Microbial communities were isolated for denitrification capabilities.

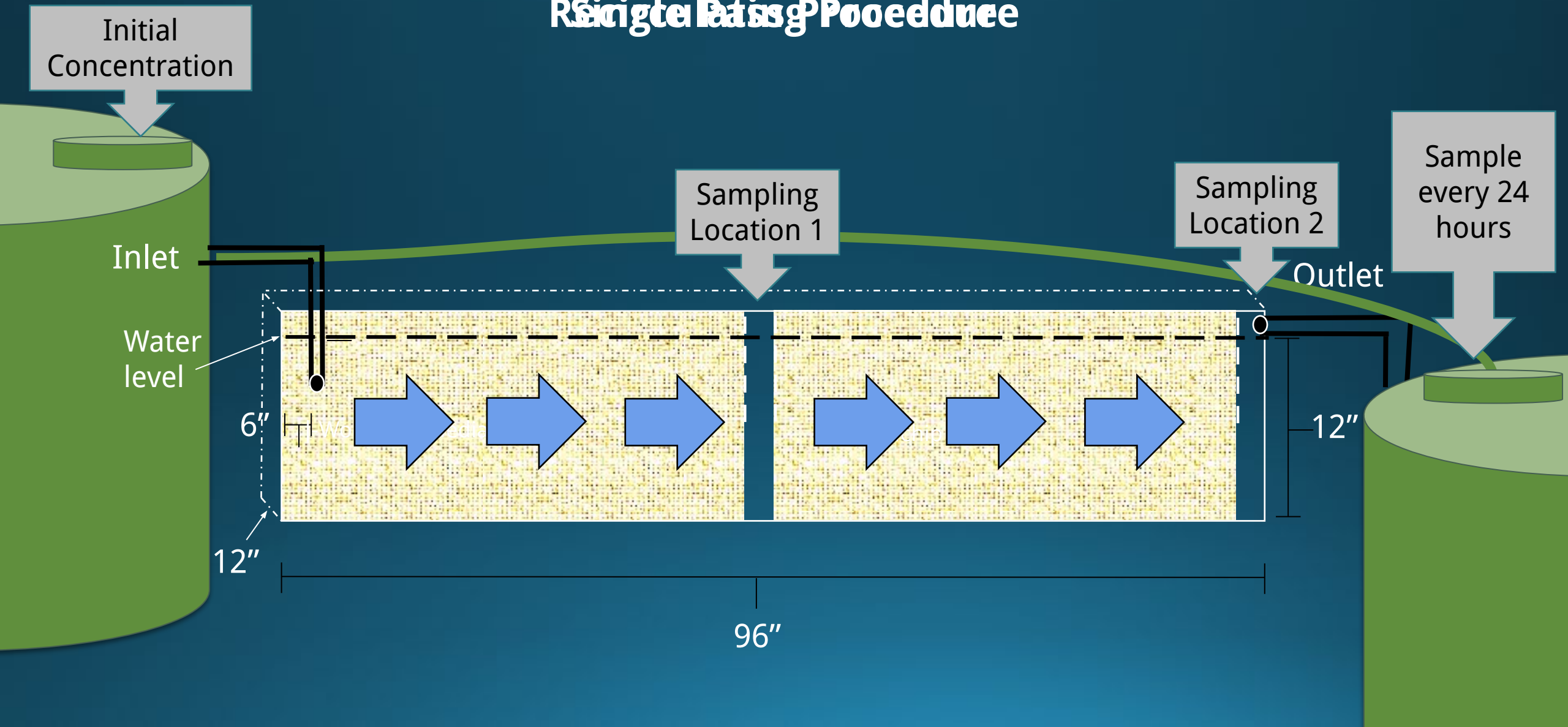


System Design

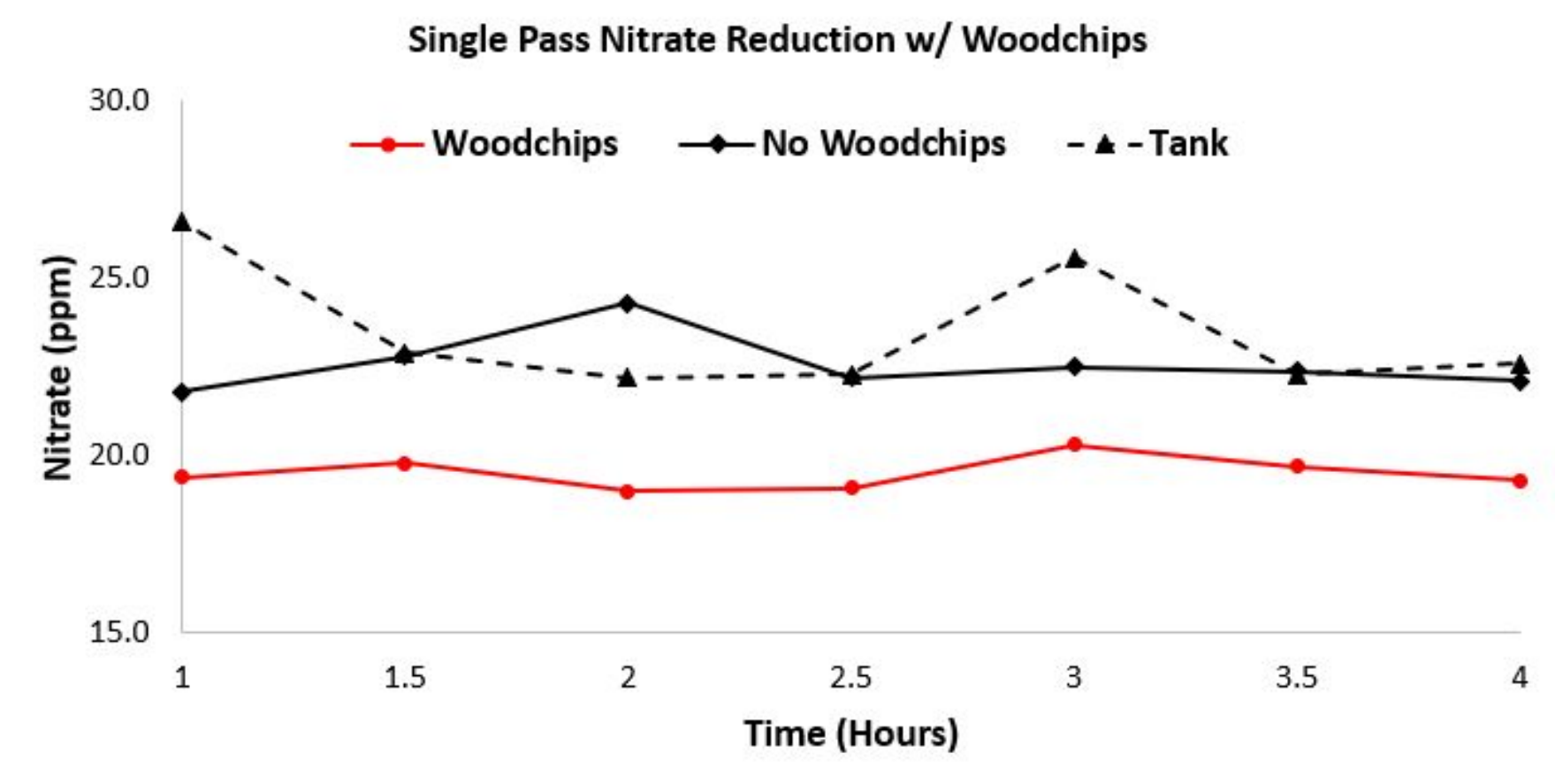
- Hoop house provides heat
- 4 insulated channels
  - 3 with woodchips
  - 1 control
- Upstream tank for dosing
- Sampling ports at midway and outlet
- Lower tank collects water

Methods

Single Pass Procedure



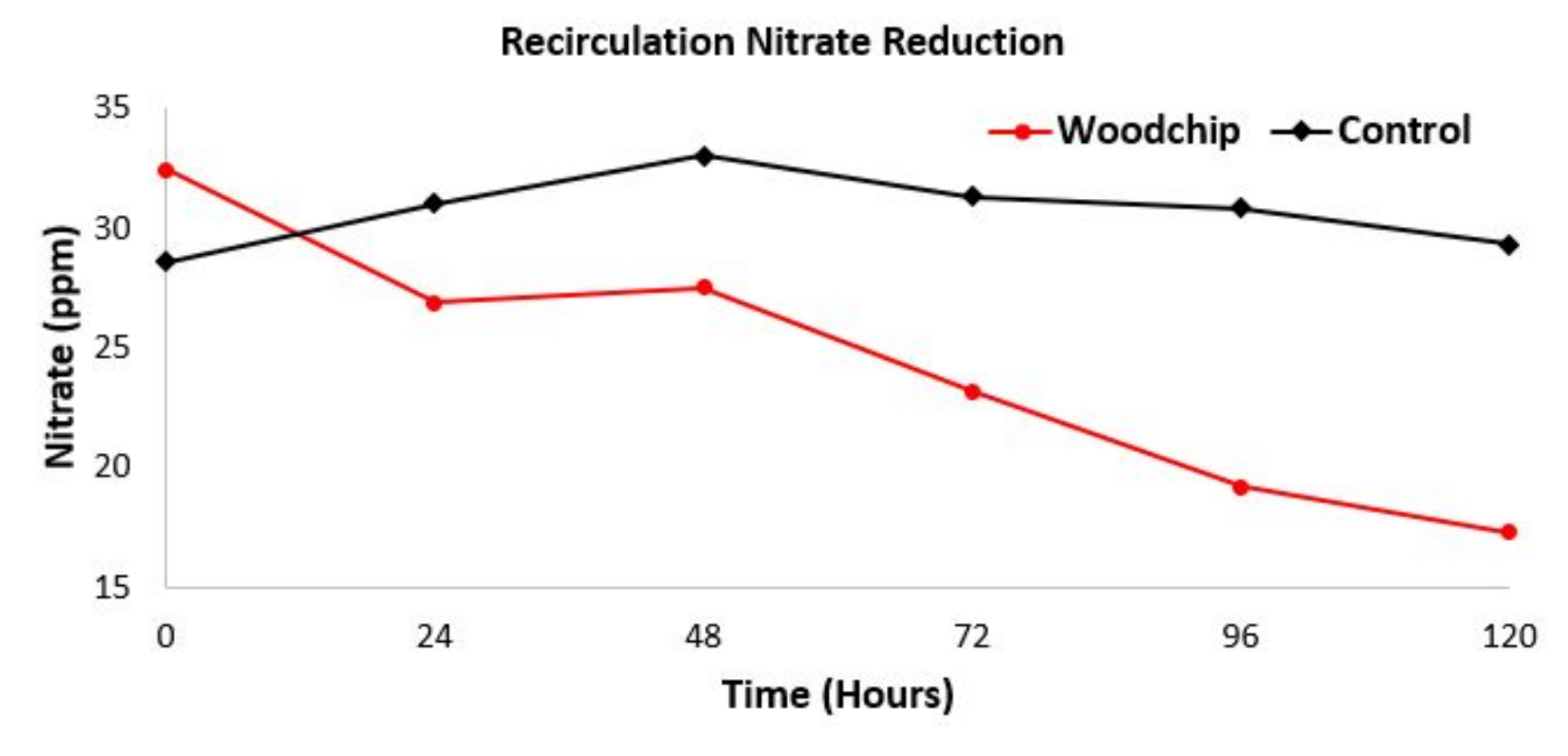
Woodchip Efficiency



Average Nitrate Reduction

- Woodchip Channel: **21%**
- Control Channel: **9%**

Woodchip Efficiency



Average Nitrate Reduction

- Experimental System: **12%**
- Control Channel: **-0.6%**

Total Nitrate Reduction

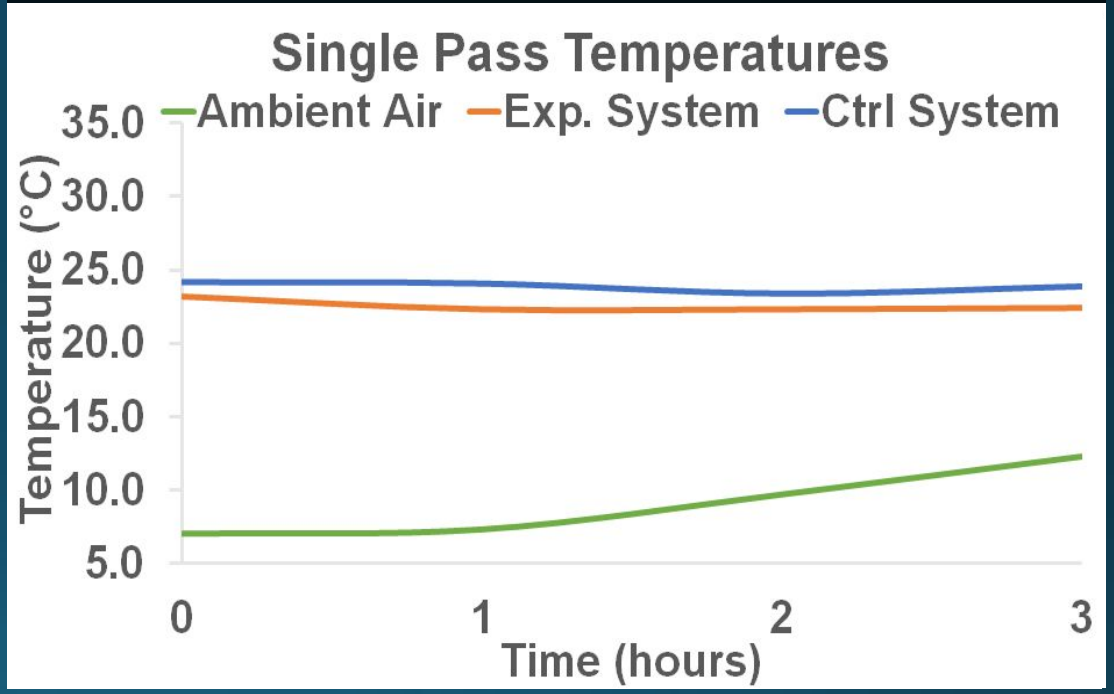
- Experimental System: 47%
- Control System: -2%

Limiting Factors

Carbon

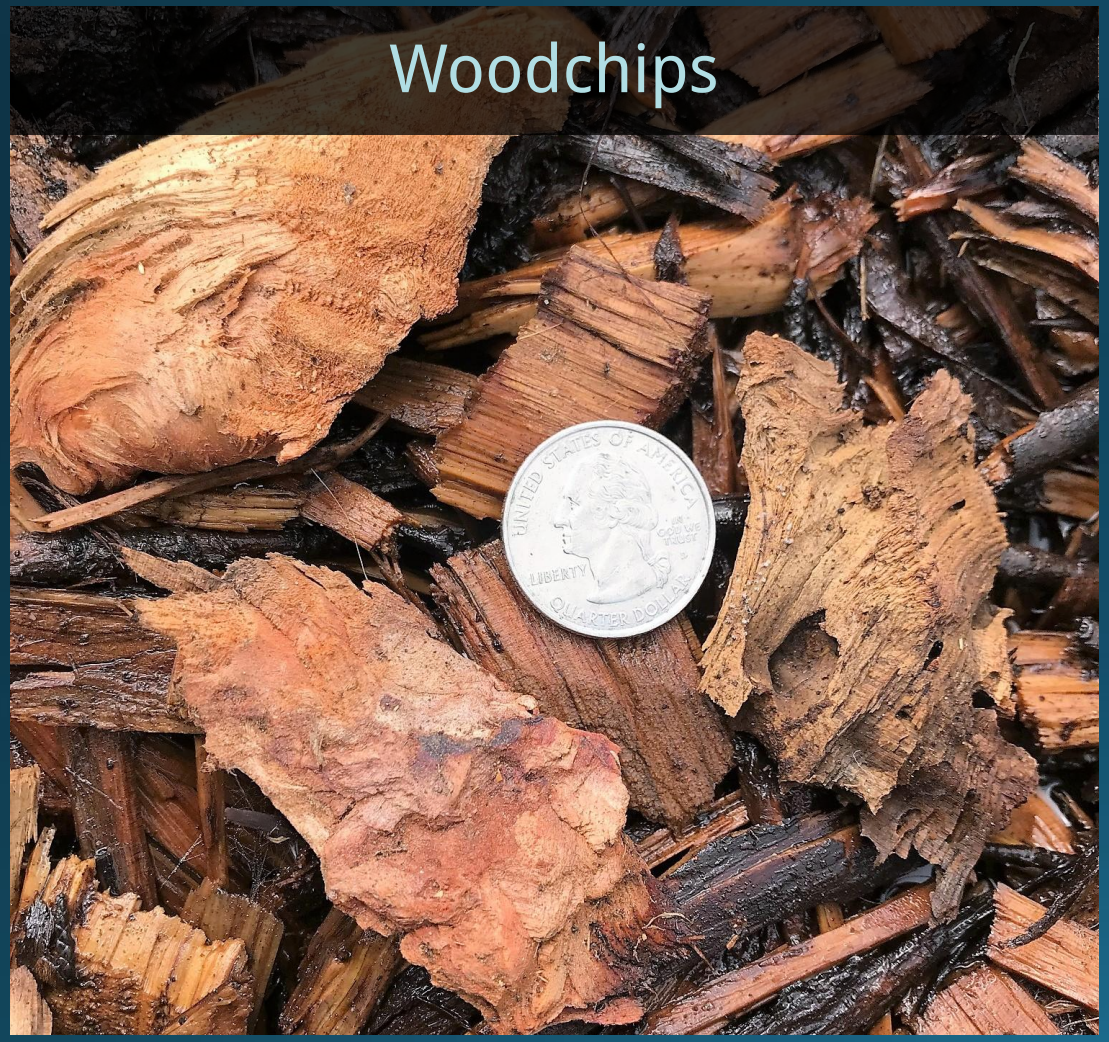
Can only use surface carbon

Temperature



Ambient air: 17°C
Ambient water: 13°C
Experimental: 22°C

Carbon Supplementation



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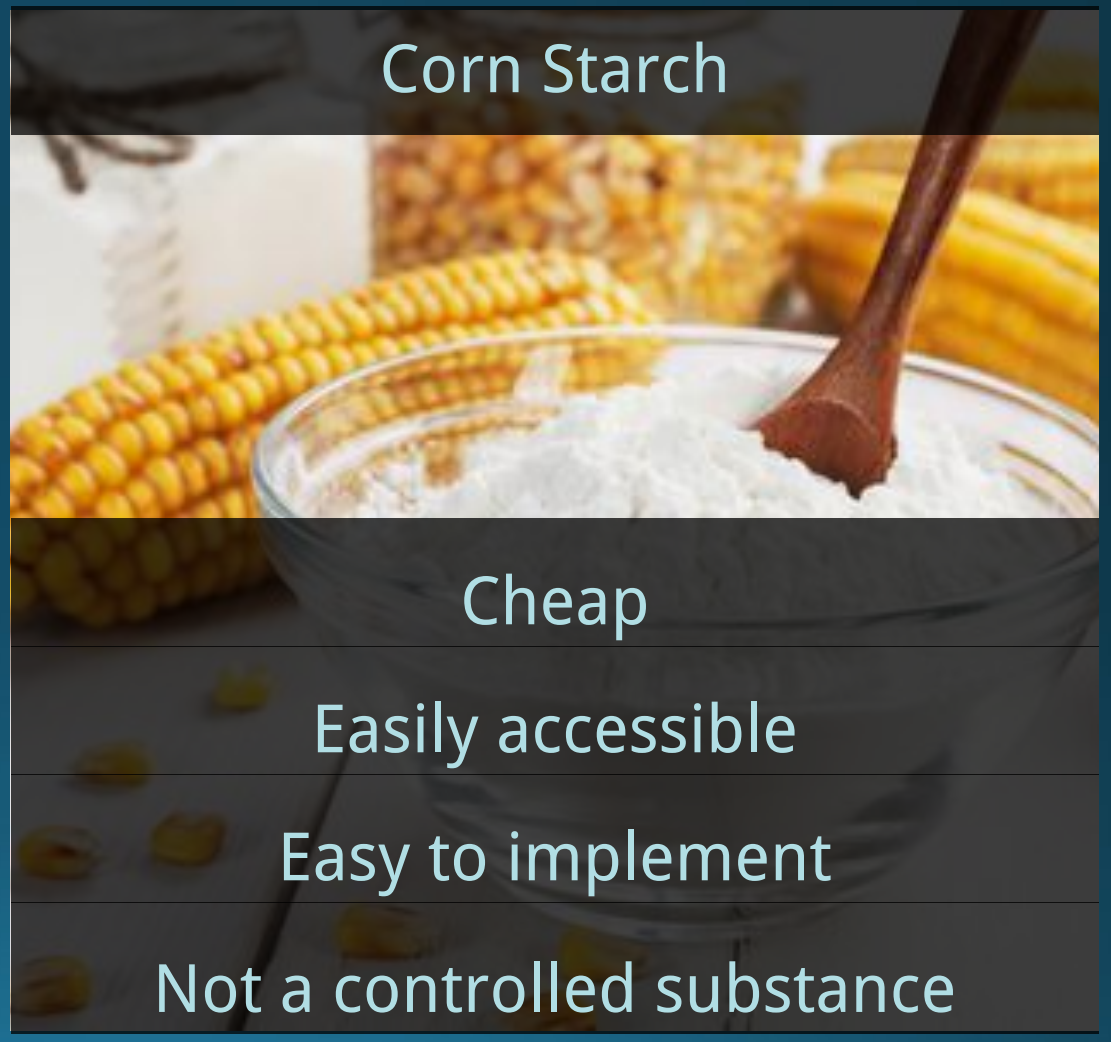
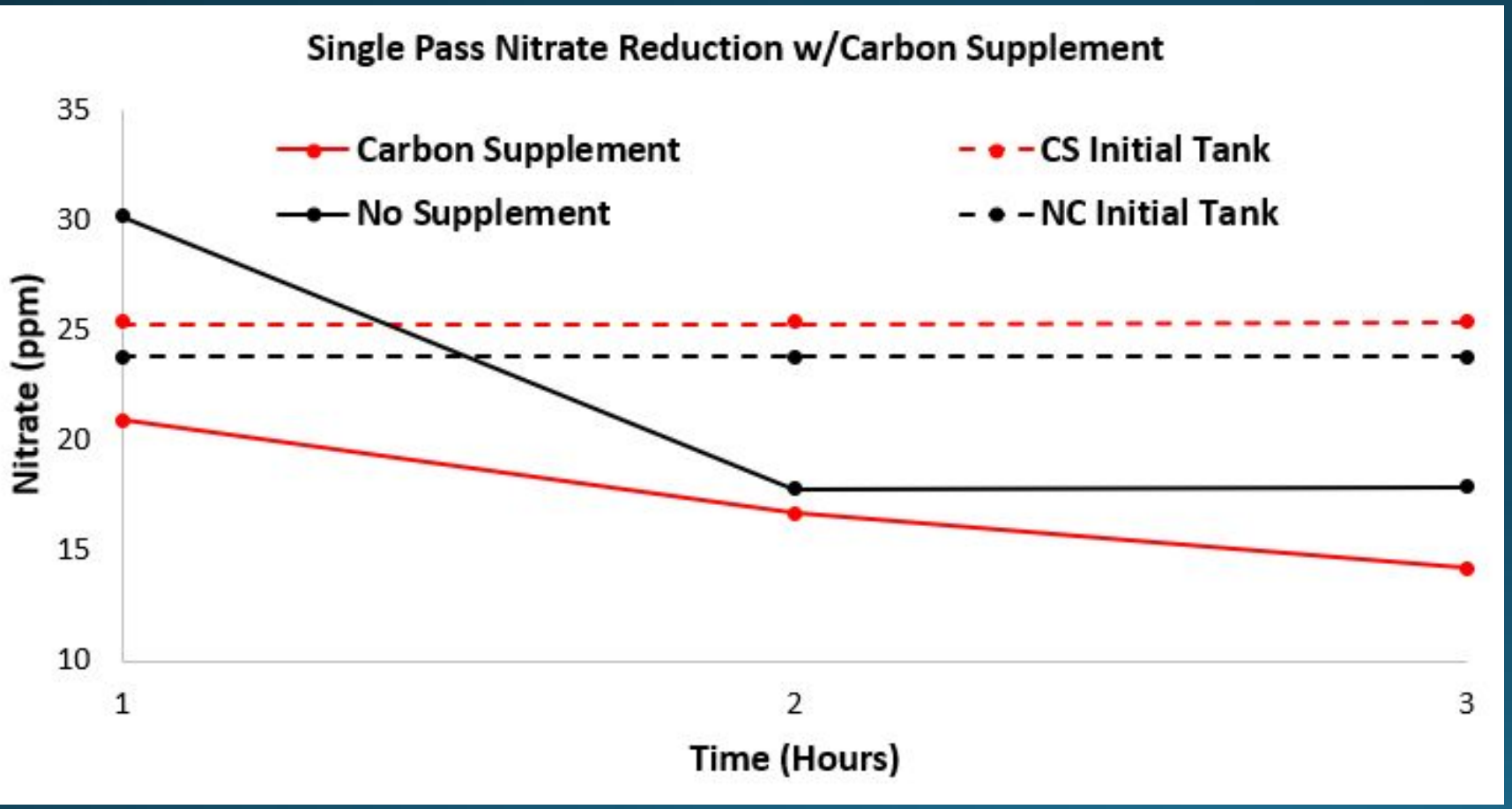


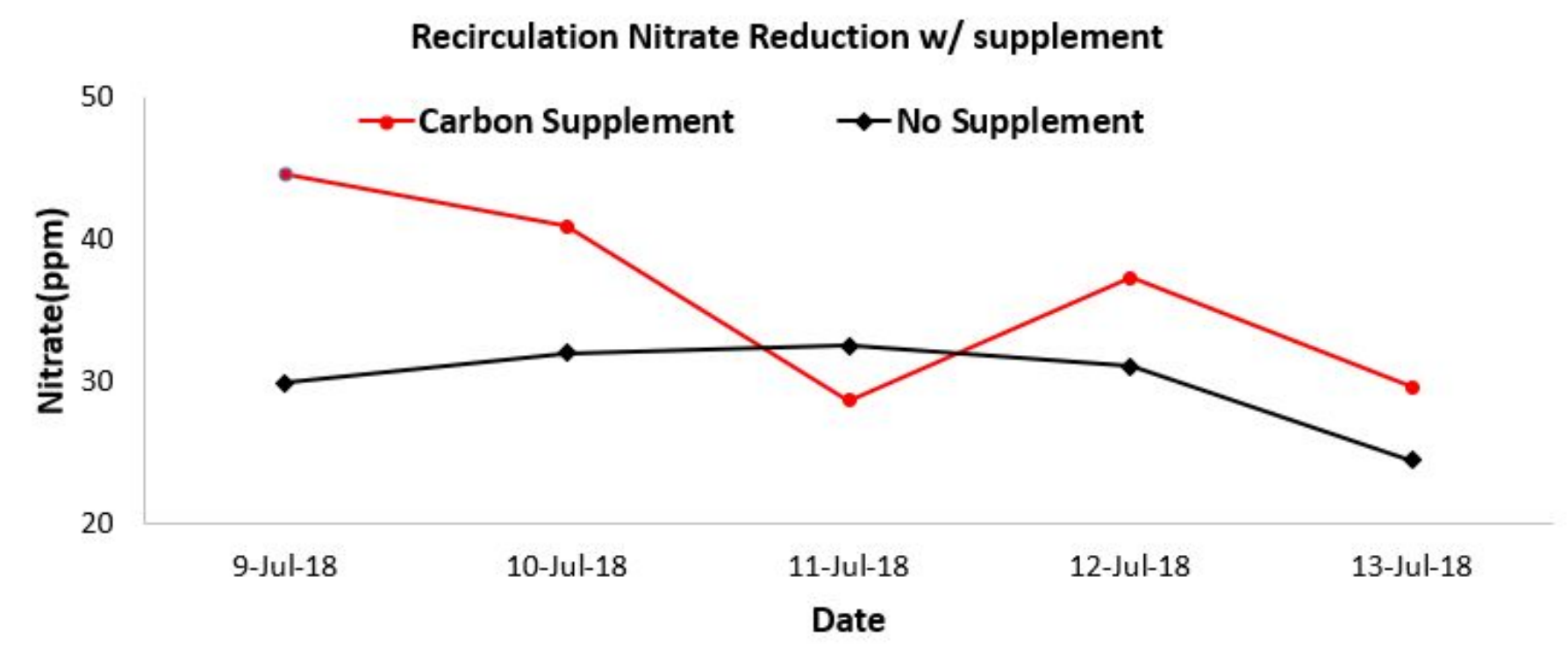
Results



Average Nitrate Reduction (overall)

- Carbon Supplement: **33%**
- No Supplement: **16%**

Results



Average Nitrate Reduction (overall)

- Carbon Supplement: **14%**
- No Supplement: **6%**

Results

Test	T - Value	Degrees of Freedom	Mean of X and Y	P - Value
Single Pass CS vs NCS	2.48	131	1.67 - 2.41	**0.007**
Recirculation CS vs NCS	1.30	20.4	14.1 - 5.89	**0.105**

There was a significant difference observed between single pass experiments with cornstarch (CS) and without cornstarch (NCS).

There was no significant difference observed between recirculation experiments with and without cornstarch.

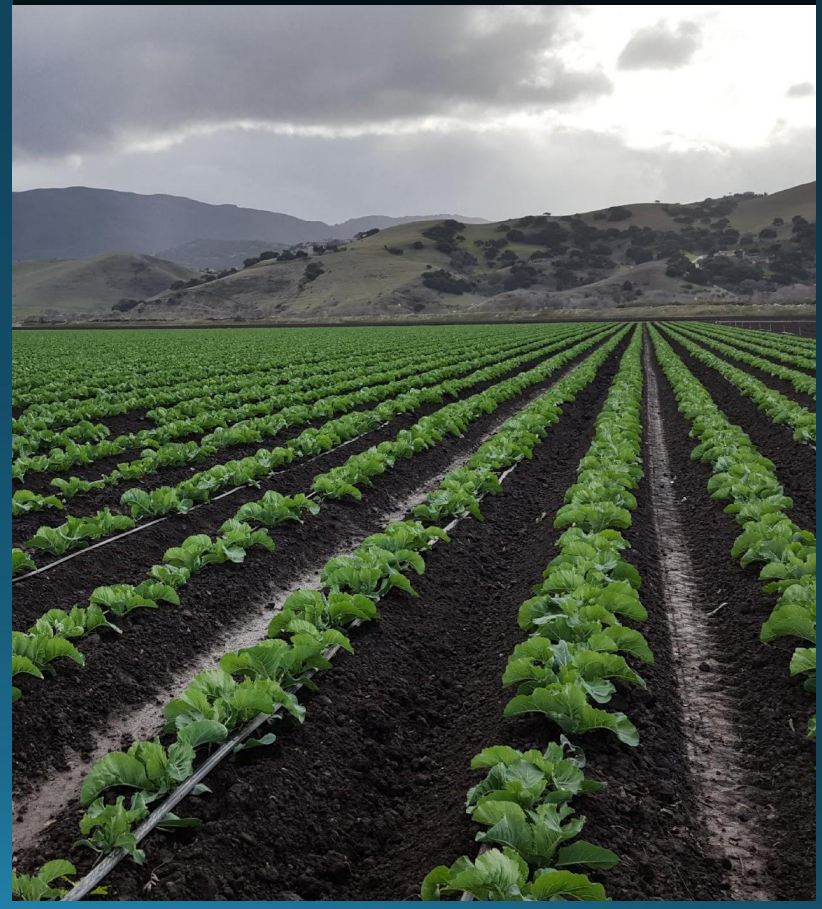
Discussion

Recirculation experiments were limited by sample size.

Addition of cornstarch corresponds to higher rates of denitrification.

https://en.wikipedia.org/wiki/Starch

Full scale applications can contribute to sustaining agriculture.



Future Work

- Further data collection on recirculation experiments to perform statistical analysis
- Remediation of other pollutants such as pesticides
- Implementation of bioreactors on agricultural sites

References

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