Studying the effects of geologic nitrogen on carbon cycling

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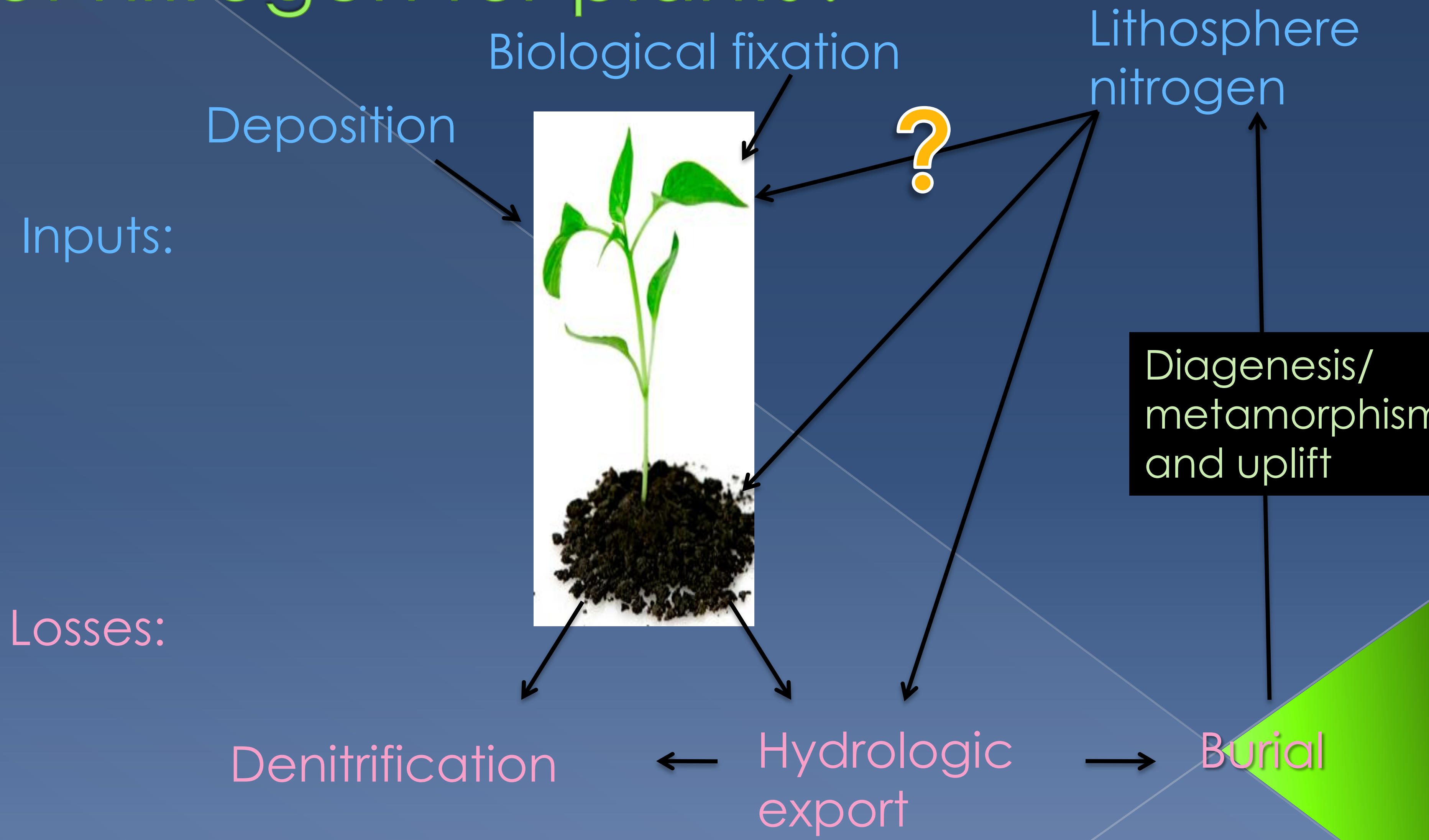
Presentation overview

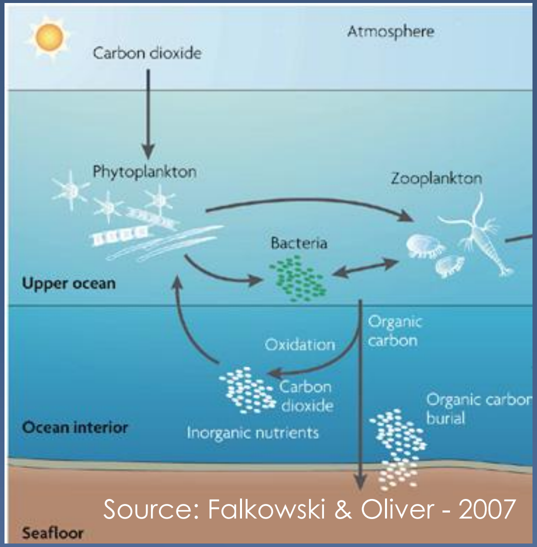
- Background of project
- Research question
- Experiment setup
- Results
- Discussion
- Conclusion

Geologic N as a possible source of nitrogen for plants?



Formation of geologic N

Accumulation and burial of organic matter → Diagenesis → Low-grade metamorphism



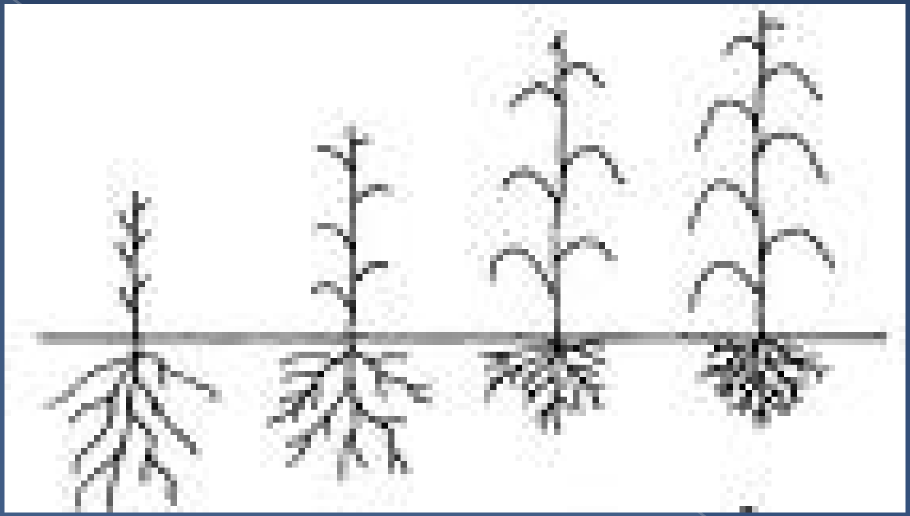
Source: Falkowski & Oliver - 2007

Source: Wikipedia

Organic N in shale and mudstones

Fixed NH_4^+ in mica

Root to shoot ratios



Source: waternut.org

- Low nutrient levels result in a high root to shoot ratio
- As nutrient levels increase the root to shoot level will decrease

Research goal:

- To understand how geologic nitrogen impacts the carbon cycle and if it is an available source of nutrients for plants.

Research question:

- How does geologic nitrogen impact biomass production?
  - More specifically how will geologic nitrogen effect root to shoot ratios?
- Can this be correlated to plant nutrition?

Hypothesis:

- Plants without geologic N sources will have the highest root to shoot ratios (the lowest above ground biomass)
- Plants with geologic N inputs will show decreased root to shoot ratios as the plant can spend more nitrogen on above ground biomass production; however there may be a threshold for increased biomass production as other nutrients limit plant growth

The project

- Pot Study in a growth chamber
  - Controlled temperature
  - Controlled photo period
- Species: *Bromus carinatus*
- Grown from July 24 - October 25

The project (continued)

- Four treatments
  - Silica
  - Silica + Nitrogen fertilizer
  - Geologic Nitrogen
  - Geologic Nitrogen + Nitrogen fertilizer

Nutrient management within the project

- Solution
  - Started with solution comprised of
    - $Ca(H_2PO_4)_2$, $CaSO_4$, K_2SO_4, $MgSO_4$, Na_2MoO_4, and a micronutrient solution
  - Diluted original solution by ½ strength
  - Changed again (removed CaSO4)
- Those treatments that received N fertilization
  - $(NH_4)_2SO_4$
  - Applied 3 times

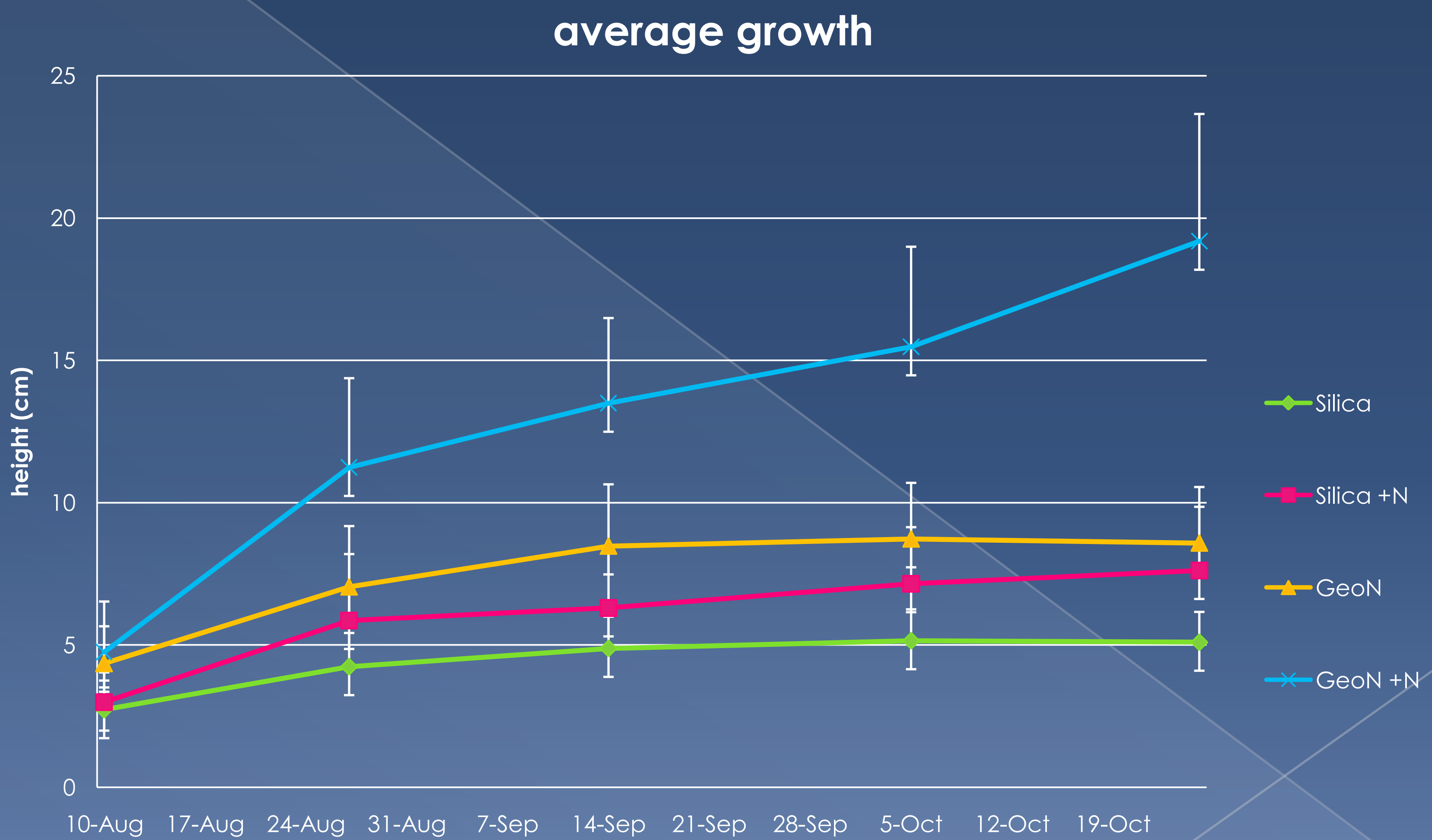
Nutrient additions- total

Macronutrients	**mmols**	**g/m2**	**kg/ha**
Phosphorus	0.400	7.67	76.71
Calcium	0.743	9.09	90.91
Magnesium	2.510	21.41	214.07
Potassium	0.799	6.81	68.14
Sulfur	2.376	20.26	202.64
Micronutrients	**µmols**	**g/m2**	**kg/ha**
Boron	0.002	0.00002	0.0002
Cu	0.073	0.00062	0.0062
Iron	0.613	0.00523	0.0523
Mn	0.052	0.00044	0.0044
Zn	0.483	0.00412	0.0412
Mo	0.080	0.00069	0.0069

	mmols	**g/m2**	**kg/ha**
Nitrogen Additions	2.84	10.95	109.53

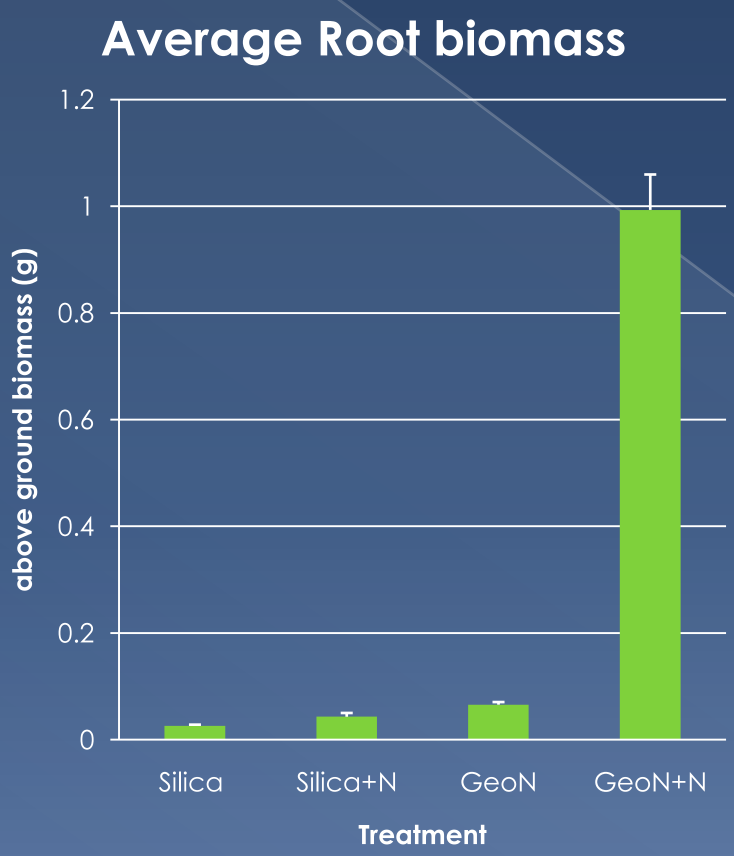
N:P (mol:mol) = 7:1

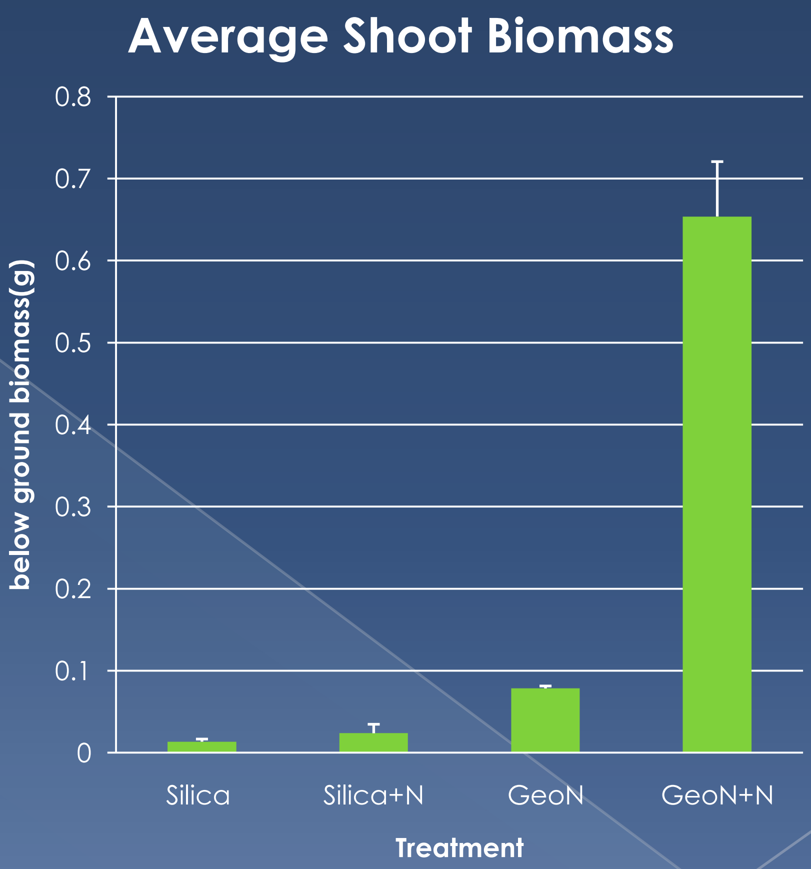
Results: average growth



* Error bars represent standard deviation

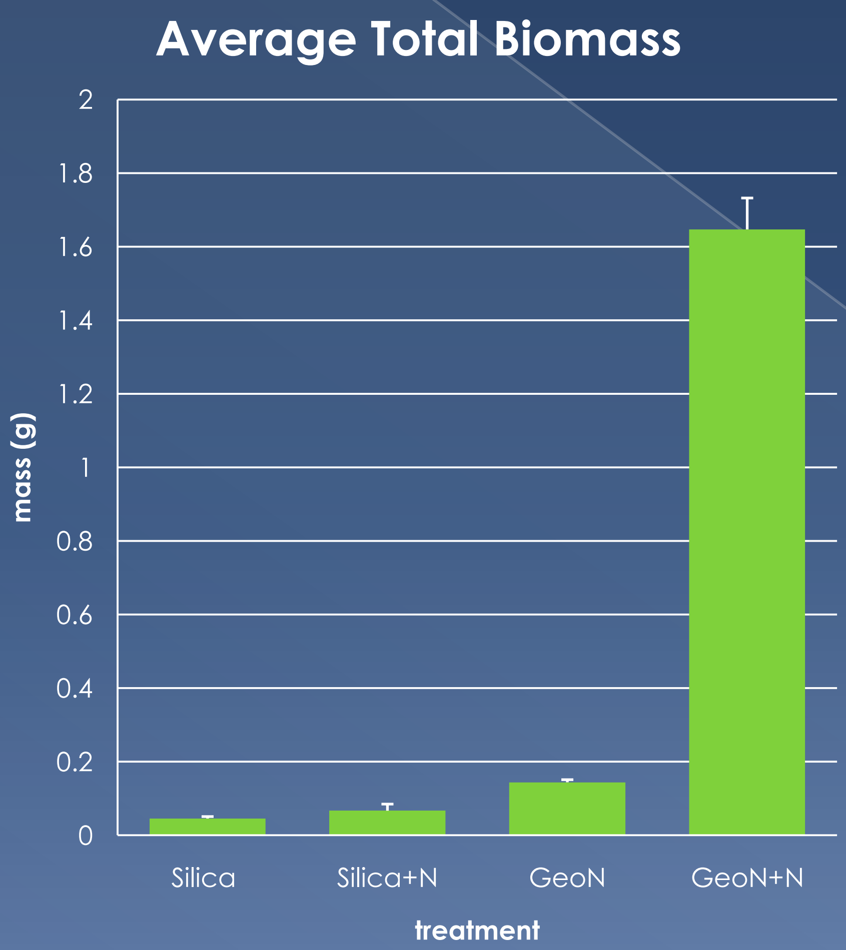
Results: average biomass





* Error bars represent standard deviation

Results: average total biomass



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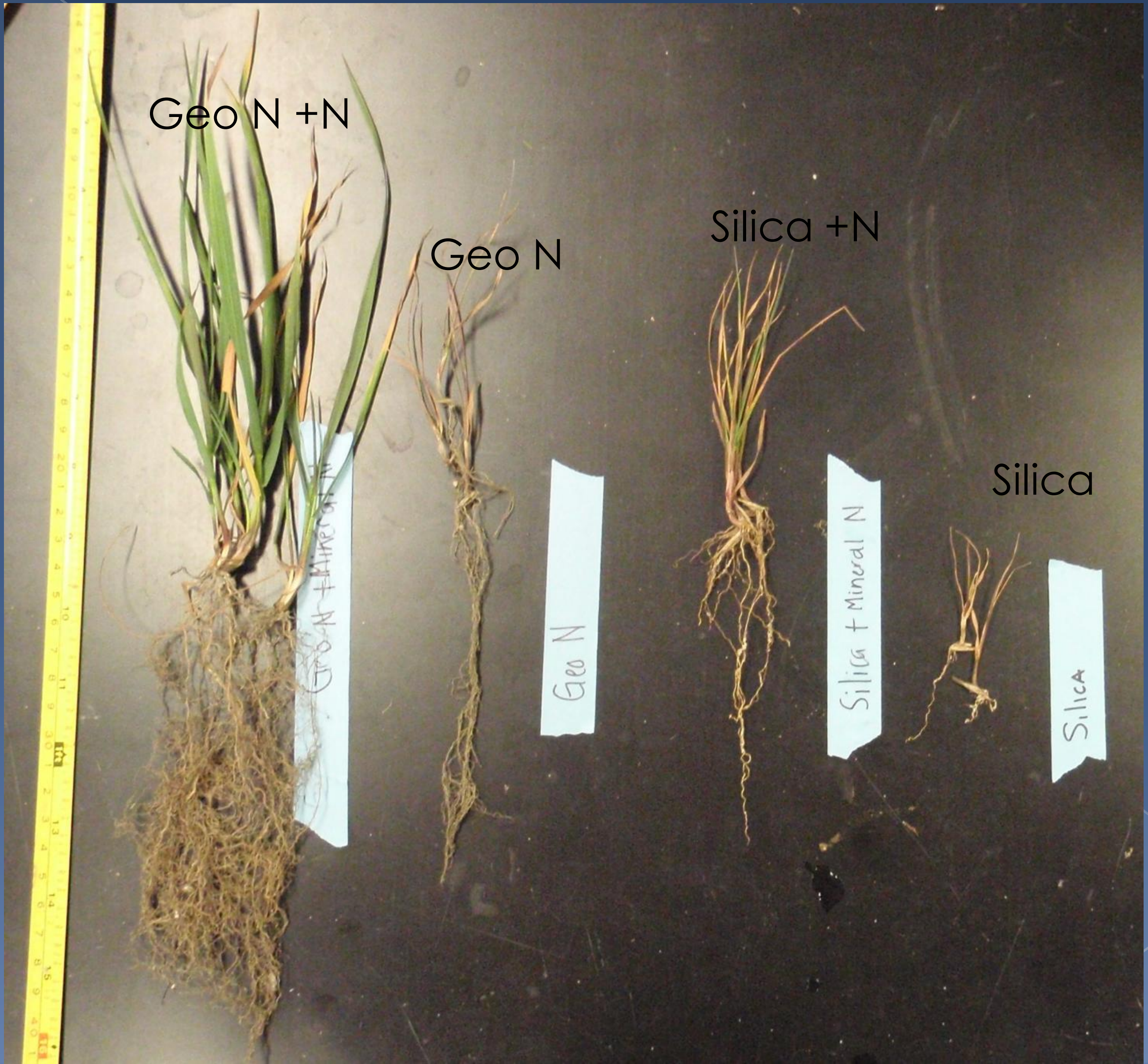
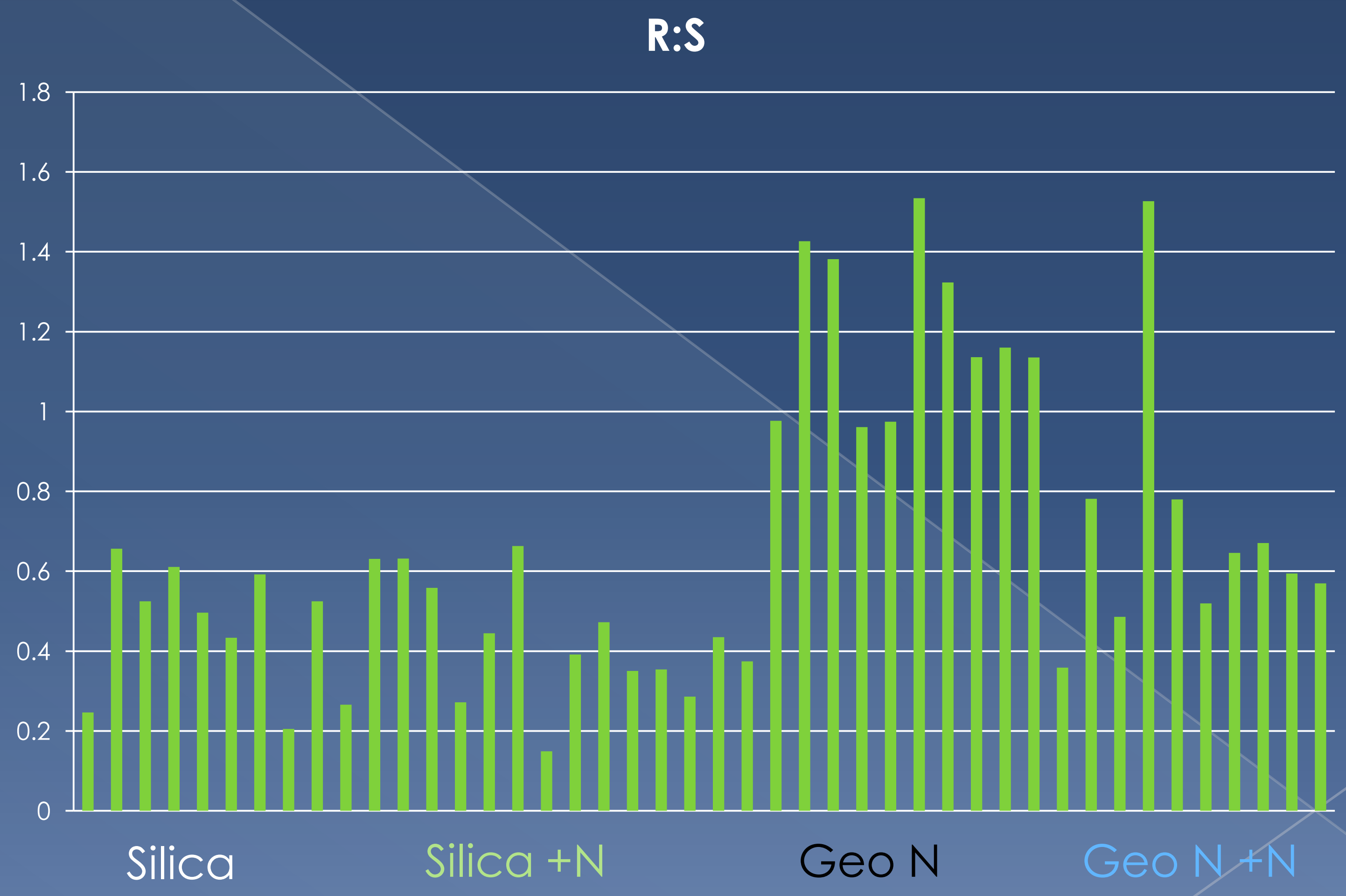
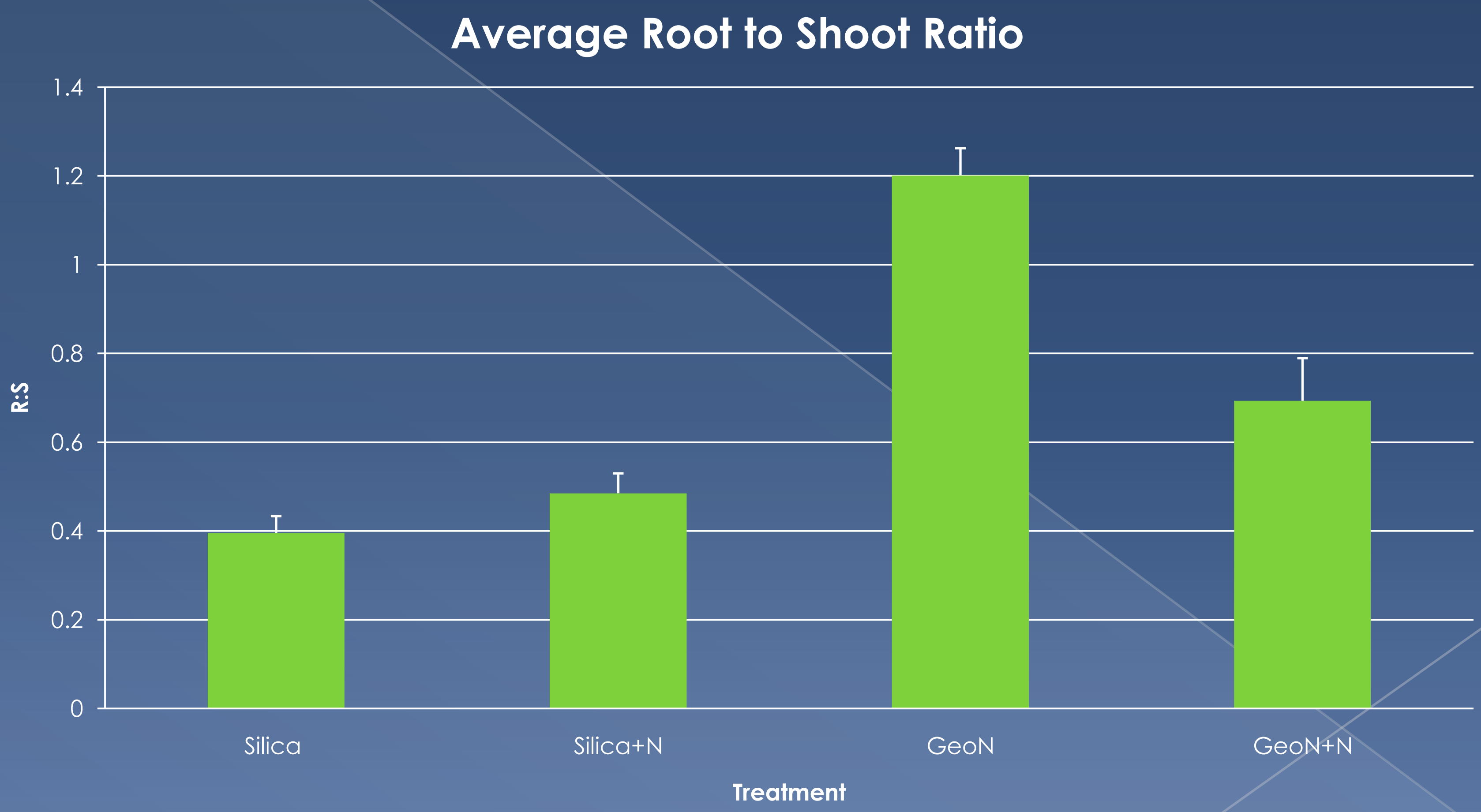
Root to shoot in the project



Results: root to shoot ratios for all plants



Results: average root to shoot ratio



* Error bars represent standard deviation

Results summary

- Average growth:
  - Geo N+N had the greatest growth followed by geo N, then silica + N, with silica expressing the least average height
- Root to shoot ratios:
  - Geo N had the highest root to shoot ratio, followed by geoN+N, then silica + N, to silica showing the lowest ratios
- Average biomass:
  - Geo N+N overwhelmingly had the greatest biomass followed by geo N, then silica + N, with silica having the least average biomass
- Average root biomass:
  - Geo N+N had the greatest root biomass followed by geo N, then silica + N, and silica
- Average shoot biomass:
  - Geo N+ N had the greatest shoot biomass, followed by geo N, silica + N, with silica having the least shoot mass

Discussion

- Root to shoot ratios did not come out as hypothesized
  - Possible explanations for resultant R: S ratios for each treatment
    - Silica- did not have enough nutrients to invest in root growth to mine for more nutrients
    - Silica +N- may have increased roots to mine but received no benefit and stopped increasing roots
    - Geo N- increased root mass to mine for nutrients and received benefit so continued to increase root mass
    - Geo N+N- did some root mining and received some benefit but also had other sources of N

Conclusions

- Geo N treatment had greater biomass than both the silica and the silica +N suggesting that N was available
- Root biomass did not follow the expected trend
- The increased root to shoot ratios in the Geo N pots suggest that the plants are receiving some benefit from the Geo N fertilization otherwise the plant would not continue to invest in root growth- however the extent of production affectation is undetermined

Conclusions (continued)

- The extent to which geo N impact plant growth is unknown because of other nutrient limitations not accounted for in this study