from phosphorous-rich media to soil and wheat

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SUMMARY

In the frame of the AlgalFertilizer project, we studied wheat growth on algaefertilized soils

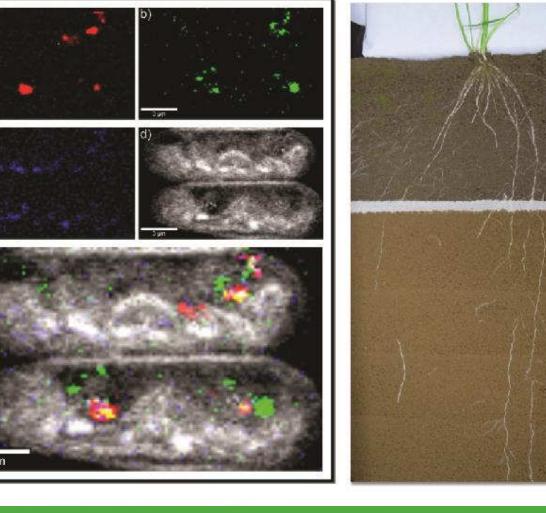
- Chlorella vulgaris, IPPAS C1 was cultivated in the large scale photobioreactor system (3 x 500 m²) in Jülich, Germany in a batch in P-rich medium.
- The algal biomass was analyzed for phosphorus content and used as fertilizer to grow wheat on sandy substrate and on nutrient-poor Null-Erde, compared to growth on nutrient-rich soil (Dachstaudensubstrat, SoMi 513).
- The algal biomass was mixed into soil substrates either in form of spray dried powder or paste of fresh cells obtained by centrifugation.
- We applied amounts of algae corresponding to 45 kg(P)/ha or to 4.5 kg(P)/ha.
- We compared the growth of wheat on algal fertilizer with standard Hoagland mineral fertilizer of corresponding concentrations.
- The experiment was performed with 150 pots, 4L each that were continuously randomized in the greenhouse by a robotic system that also ensured uniform watering. Individual plants were moved regularly with their pots into an imaging system that served to quantify the plant growth.
- We also analyzed the dynamics of nutrients in the soil.

OVERALL PROJECT STRUCTURE: AlgalFertilizer

Algae cultivation and harvesting



P- Visualization and quantitation
Algal cell
Soil with algae



Wheat growing on algae-fertilized soil



P-proteins
DNA, RNA
nucleotides, ATP, ADP
P-sugars
P-lipids
FUNCTION
Pi, cell wall bound
colloidal P
DOP, ext. dissolved organic phosphorus
biologically inaccessible

EXPERIMENT PART 1: ALGAE FOR SOIL FERTILIZATION



Chlorella vulgaris IPPAS C1 cultivation

Harvesting & biomass P-analysis

Application to different soils as

- fresh biomass paste
- spray-dried powder
- high P: 45 kg(P)/ha
- low P: 4.5 kg(P)/ha

EXPERIMENT PART 2: SOILS & ALGAE



NUTRIENT-RICH REFERENCE SOIL Somi 513 POOR SOIL Null-Erde

Wet algae Dry algae High P

No addition

No addition

SAND

No

addition

Wet Dry Mineral algae fertilizer

High P

Low P

Low P

RESULTS: WHEAT ON P FROM ALGAE



Null Erde, high phosphorus

Null Erde, high phosphorus

Null Erde, high phosphorus

Null Erde, high phosphorus

OP Null Erde

Mineral HP NullErde

Wet algae HP NullErde

Wet algae HP NullErde

Sand, high phosphorus

100
90
80
70
60
50
40
30
20
10

Somi513

Mineral HP Sand
Wet algae HP Sand

Wet algae HP Sand

Null Erde, low phosphorus

Null Erde, low phosphorus

Null Erde, low phosphorus

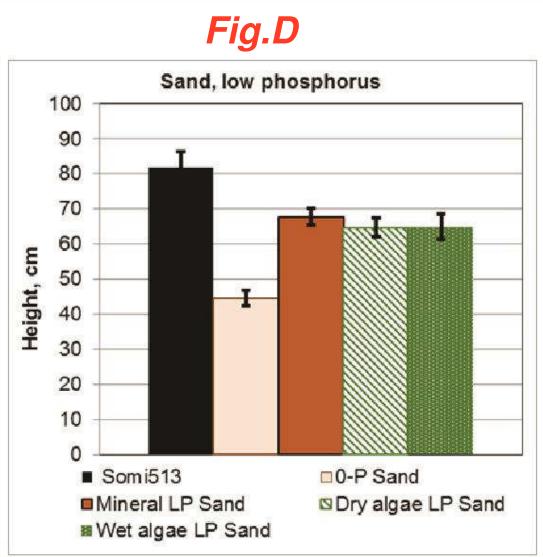
Null Erde, low phosphorus

OP Null Erde

Wineral LP NullErde

Wet algae LP NullErde

Wet algae LP NullErde



CONCLUSIONS

- Fertilization of poor-soil by algae is at the same level compared to enriched soil as well as to mineral fertilizer (Fig.A).
- Algae fertilization at high P concentrations performs slightly better on sandy substrates in comparison to mineral fertilizer (*Fig.B*).
- No significant differences in fertilization effectiveness between spray dried algae and fresh algae paste (*Figs.A-D*).

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