Simple sludge disposal with benefits? Deep - row entrenchment with agroforestry

SCHOOL of BIOLOGICAL and CONSERVATION SCIENCES

UNIVERSITY OF KWAZULU-NATAL

Craig Taylor

Faecal sludge nutrient value

Generation rate per person per day (Schouw *et al.*, 2002):

7.6 - 7.9 g N
1.6 - 1.7 g P
1.8 - 2.7 g K

1.0 - 1.1 g S
0.75 - 1.5 g Ca
0.25 - 0.4 g Mg
9 - 16 mg Zn
1.4 - 1.5 mg Cu
0.3 mg Ni
0.02 - 0.03 mg Cd
0.07 - 0.14 mg Pb
0.01 mg Hg
0.8 - 1.1 mg B

Photosynthesis

- Why examine photosynthesis?
- Measurement of photosynthesis

- Light level
- CO2 concentration
- Relative humidity
- Temperature
- Vapour pressure deficit

Photosynthesis

- Some measured parameters:

- CO_2 assimilation (A; $\mu mol.m^{-2}.s^{-1}$)

- Intracellular CO_2 concentration (Ci, $\mu mol.mol^{-1}$)

- Transpiration (E; mmol $H_20.mol^{-1}$)

- Stomatal conductance (g_s)

Photosynthesis

- Construction of curves:

- Light response curves (A-PAR curves)

- CO_2 response curves (A-ci curves)

- A is CO_2 assimilation ($\mu mol.m^{-2}.s^{-1}$)
- PAR is photosynthetically active radiation ($\mu mol.m^{-2}.s^{-1}$)
- Ci is intracellular CO_2 concentration ($\mu mol.mol^{-1}$)

Photosynthesis

- Curves analysed using non-linear regression equation:

  a*(1-Exp(b-c*ppfd//Ci)) (Causton and Dale, 1990)

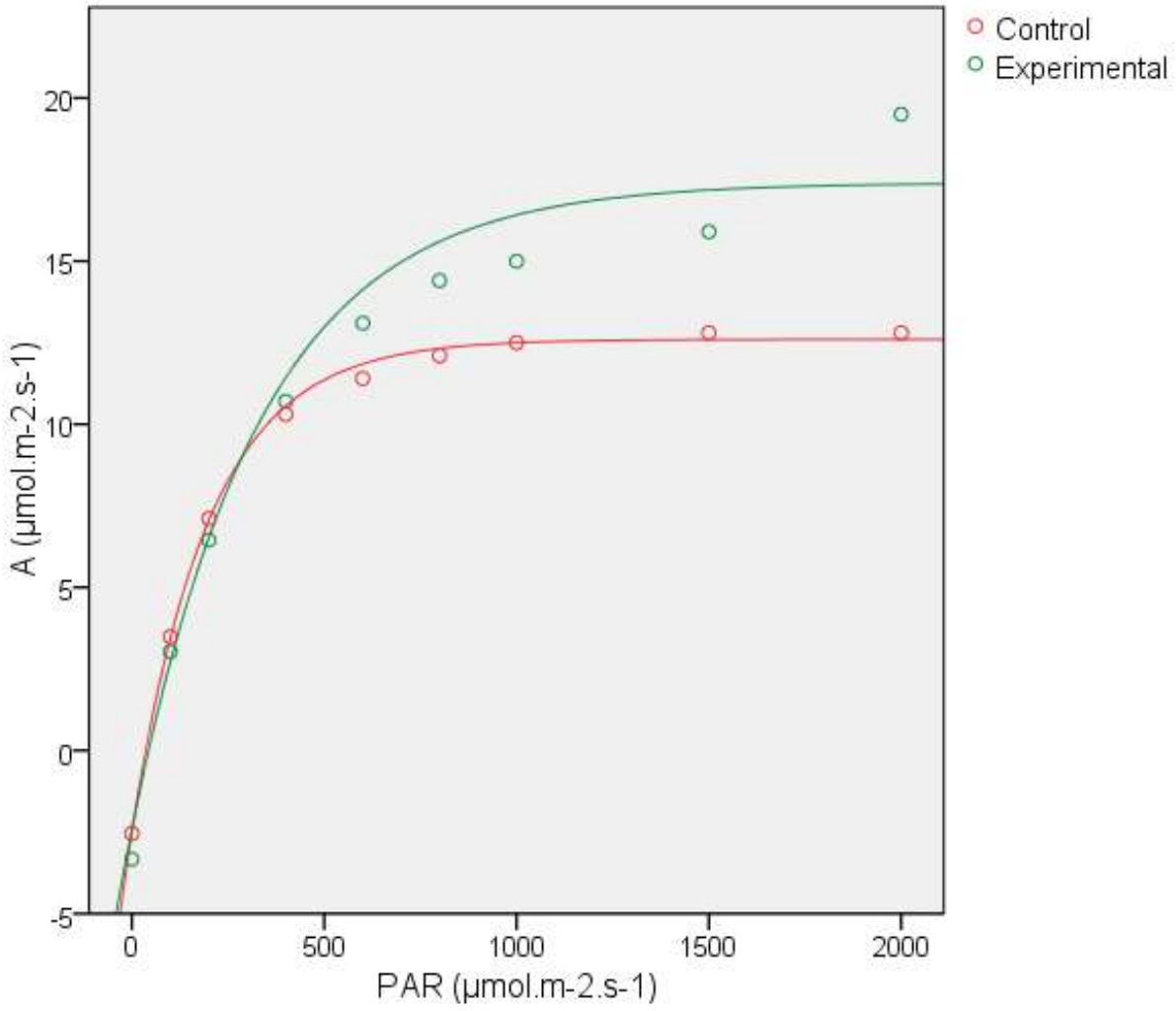
  where a, b, c are model parameters

Photosynthesis

- Derived photosynthetic parameters:

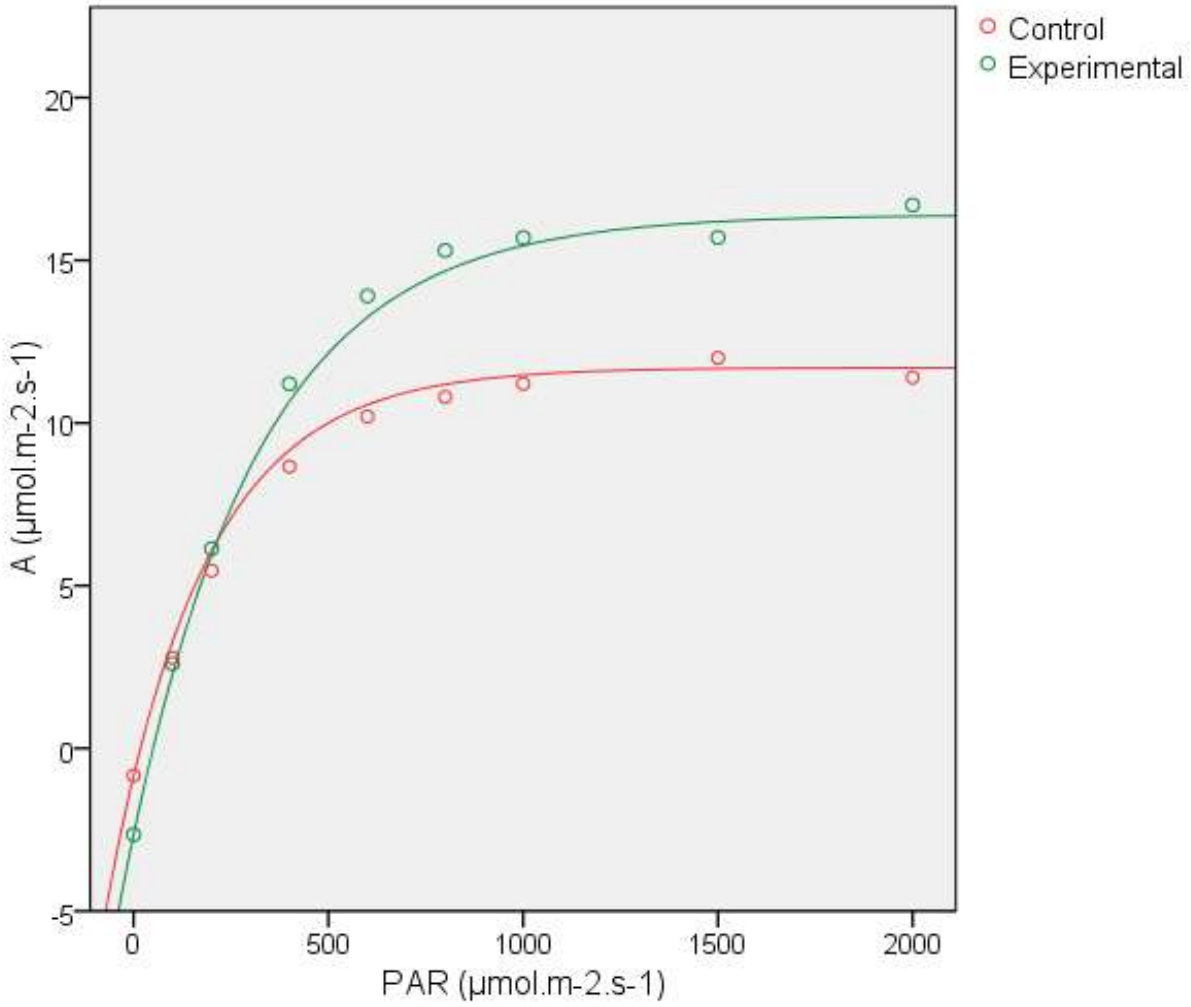
- Maximum assimilation (Amax)
- Photochemical efficiency
- Light compensation point
- Dark respiration
- Maximum electron transport (Jmax)
- Photorespiration
- Carboxylation coefficient

Light Response Curves



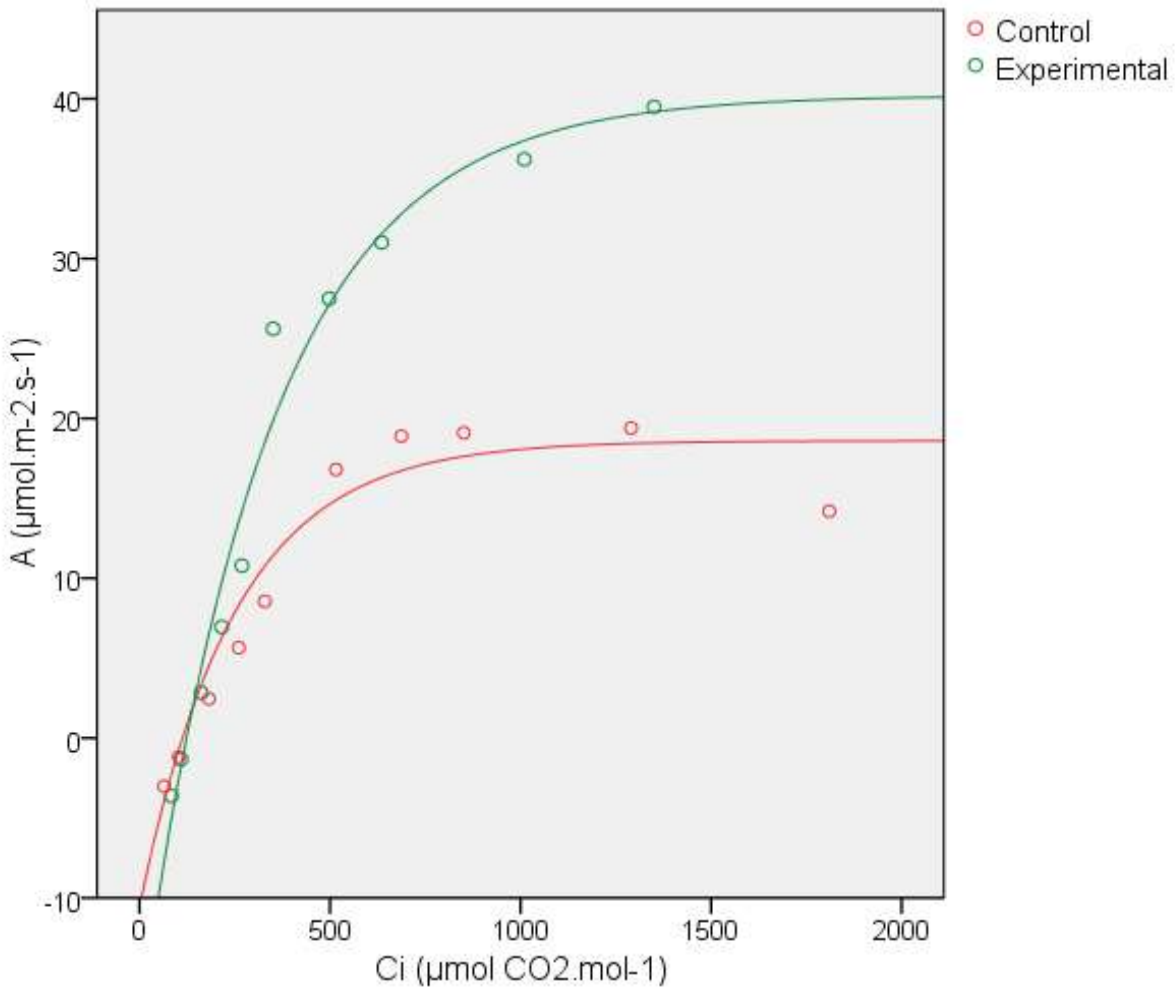
Light response curve of flooded gum

Light Response Curves



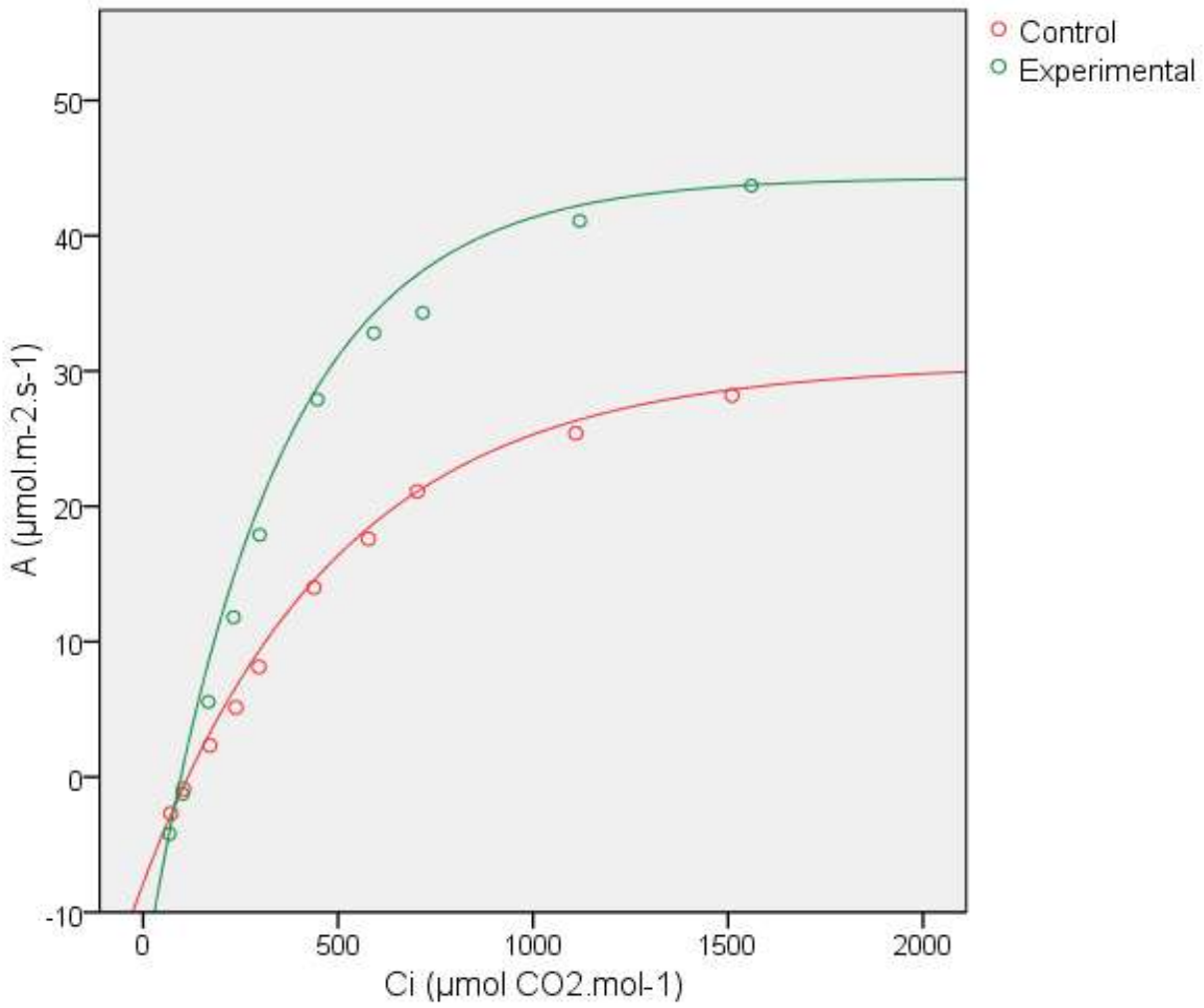
Light response curve of black wattle

CO_2 Response Curves



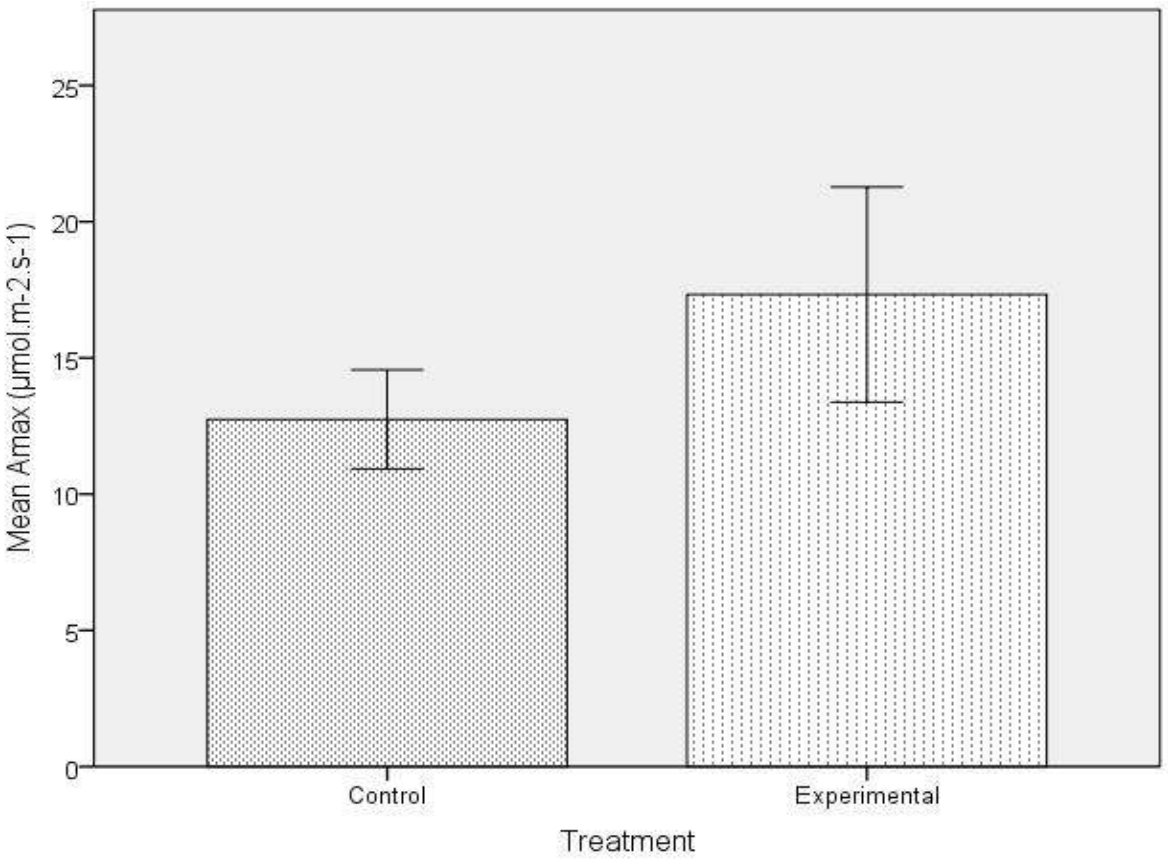
CO_2 response curve of flooded gum

CO_2 Response Curves



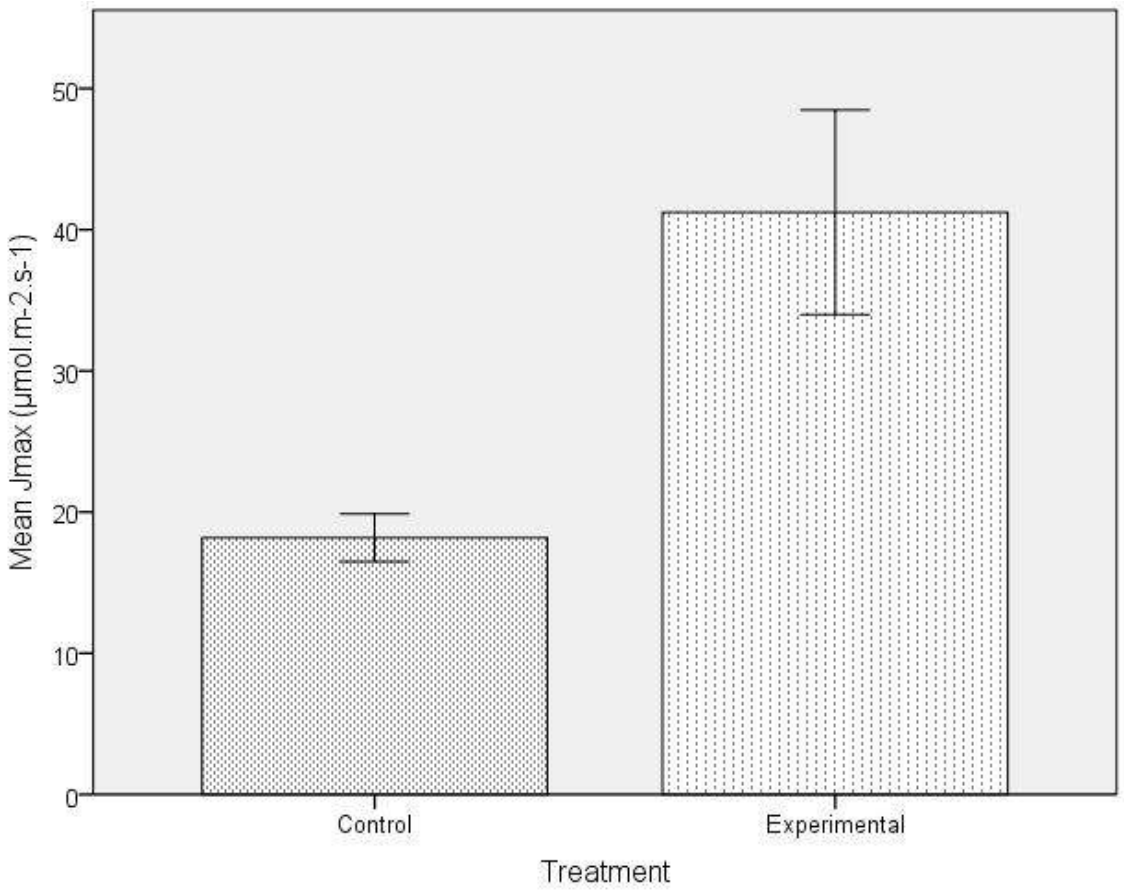
CO_2 response curve of black wattle

Photosynthetic Parameters



Maximum assimilation (A_{max}) of flooded gum

Photosynthetic Parameters



Maximum electron transport (J_{max}) of flooded gum

Plant growth - Eucalyptus

Control

Experimental

Rooting

- Root distribution evaluated using modified root intersect method (Tardieu, 1988)
- Some coarse roots penetrated faecal sludge
- Extensive lateral rooting

Rooting

Conclusion

- Faecal sludge was a valuable nutrient source
- Photosynthesis was increased relative to the control
- Tree growth compares favourably with that reported in literature

Food crop experiment

Food crop experiment

• Two species:

- Eggplant (Solanum *melongena*)
- Swiss chard (Beta *vulgaris*)

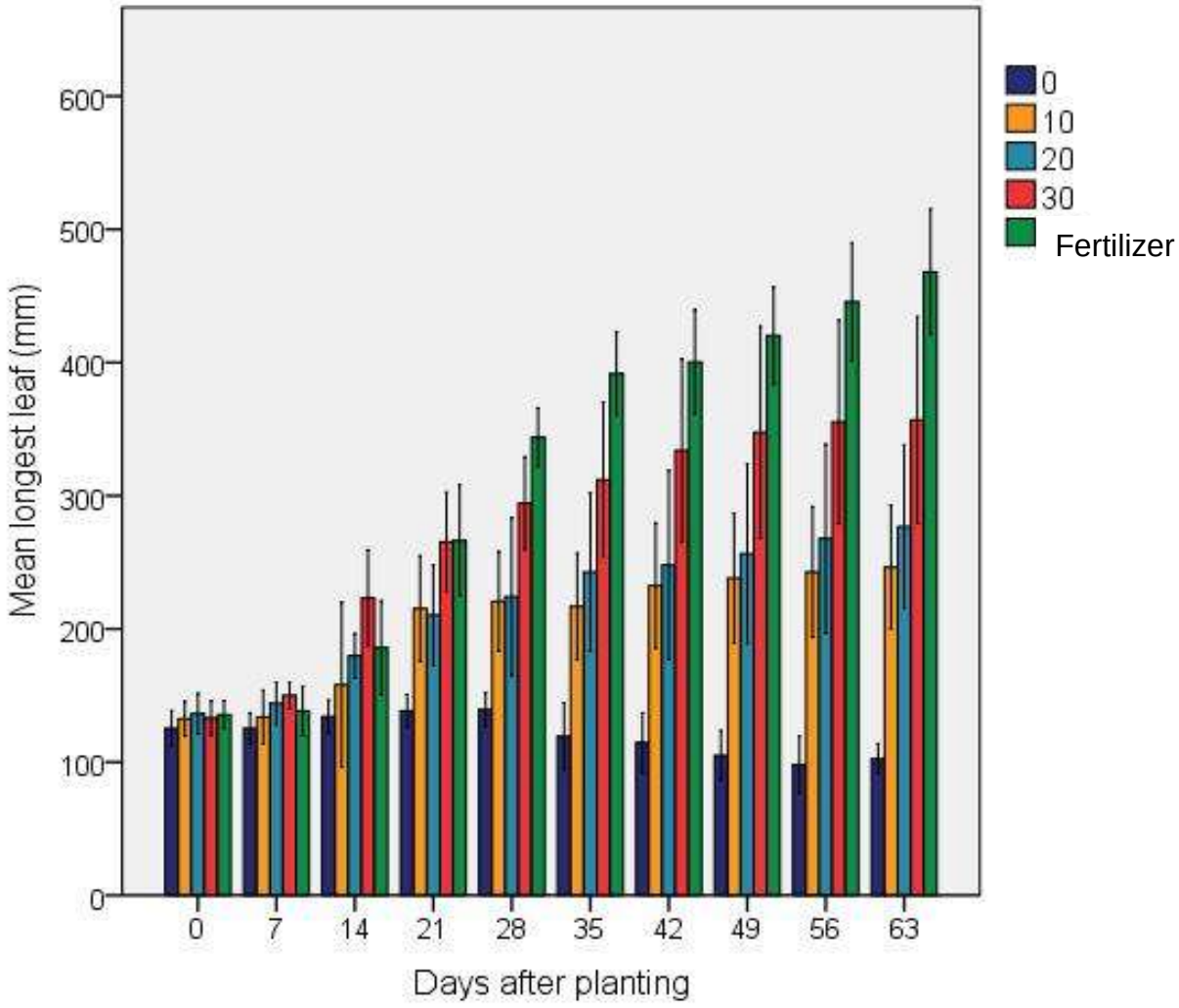
• Three application rates of sludge:

-10%, 20%, 30% (by volume).

• Controls:

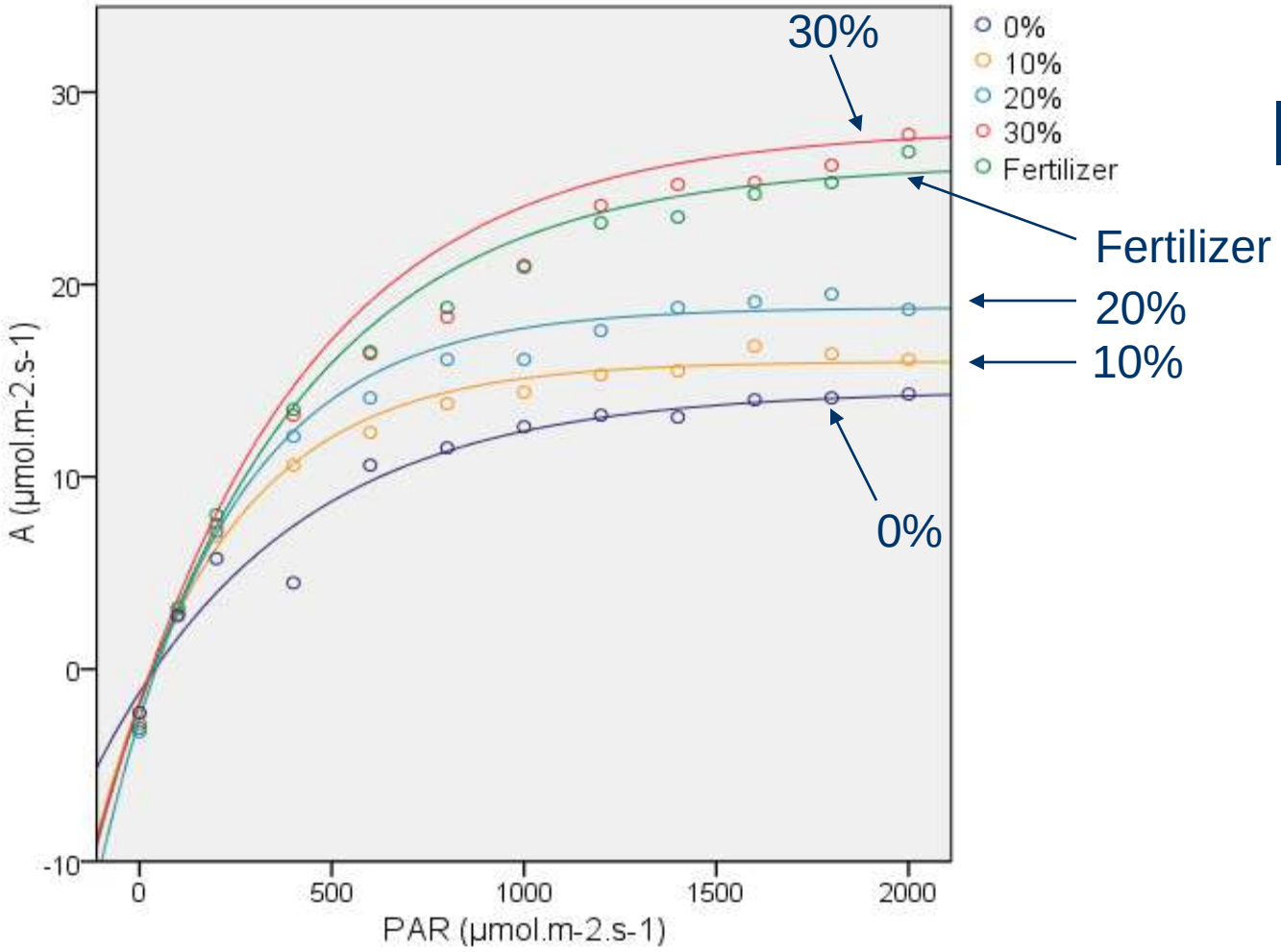
-Positive control: Hydroponics
-Negative control: Sand irrigated with water only

Growth – swiss chard



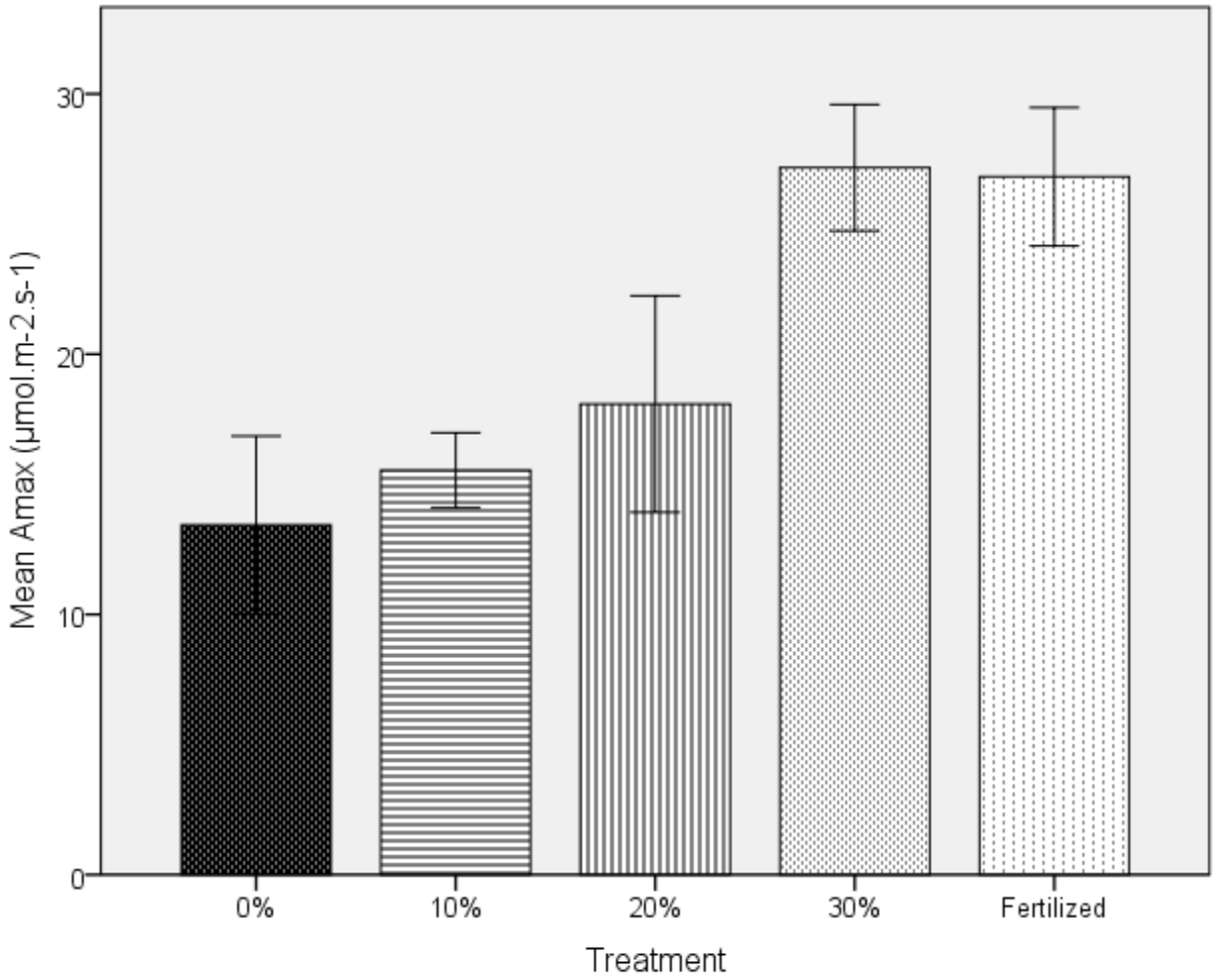
Longest leaf of swiss chard

Light Response Curve



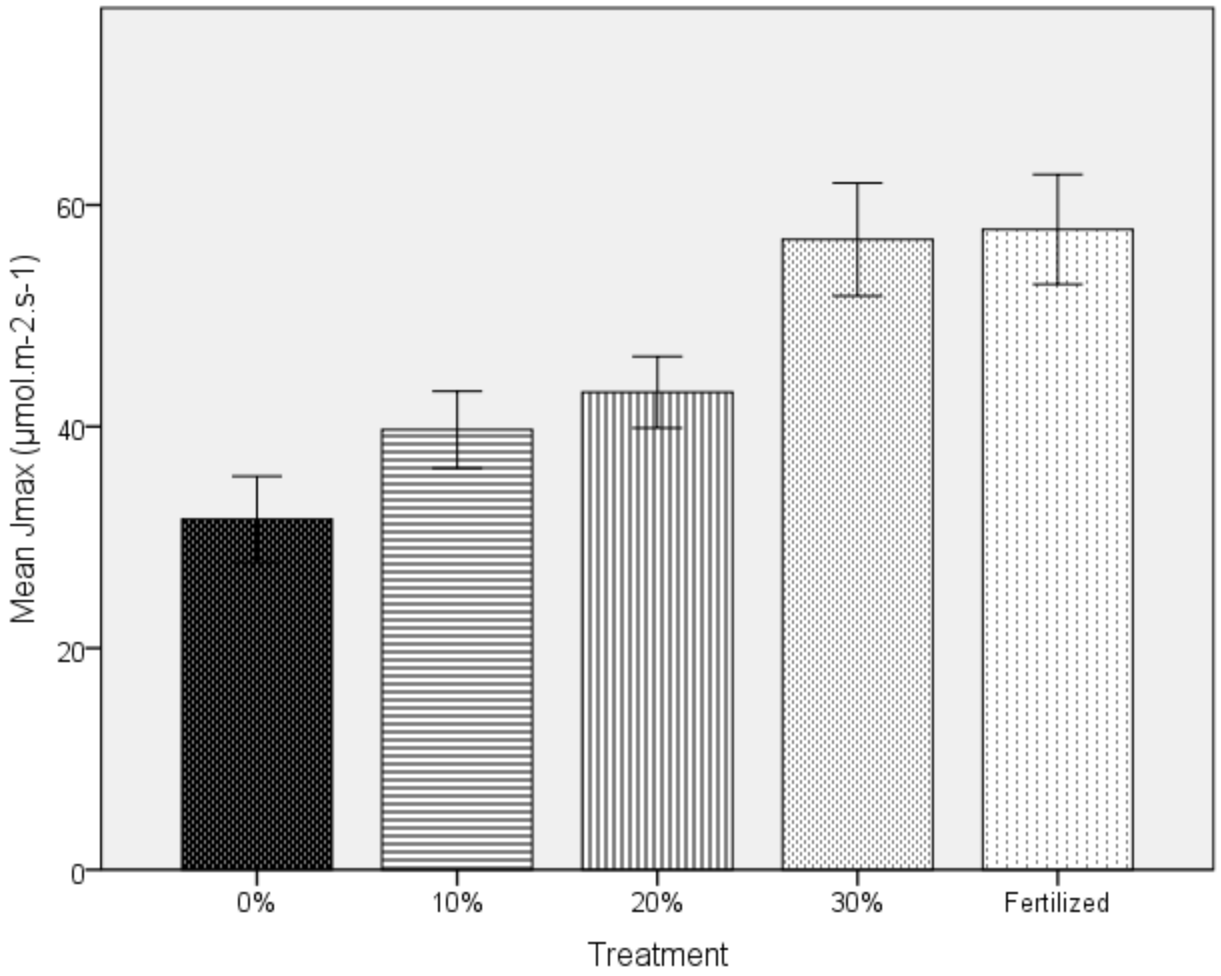
Light response curves of swiss chard

Photosynthetic Parameters



Mean A_{max} of swiss chard

Photosynthetic Parameters

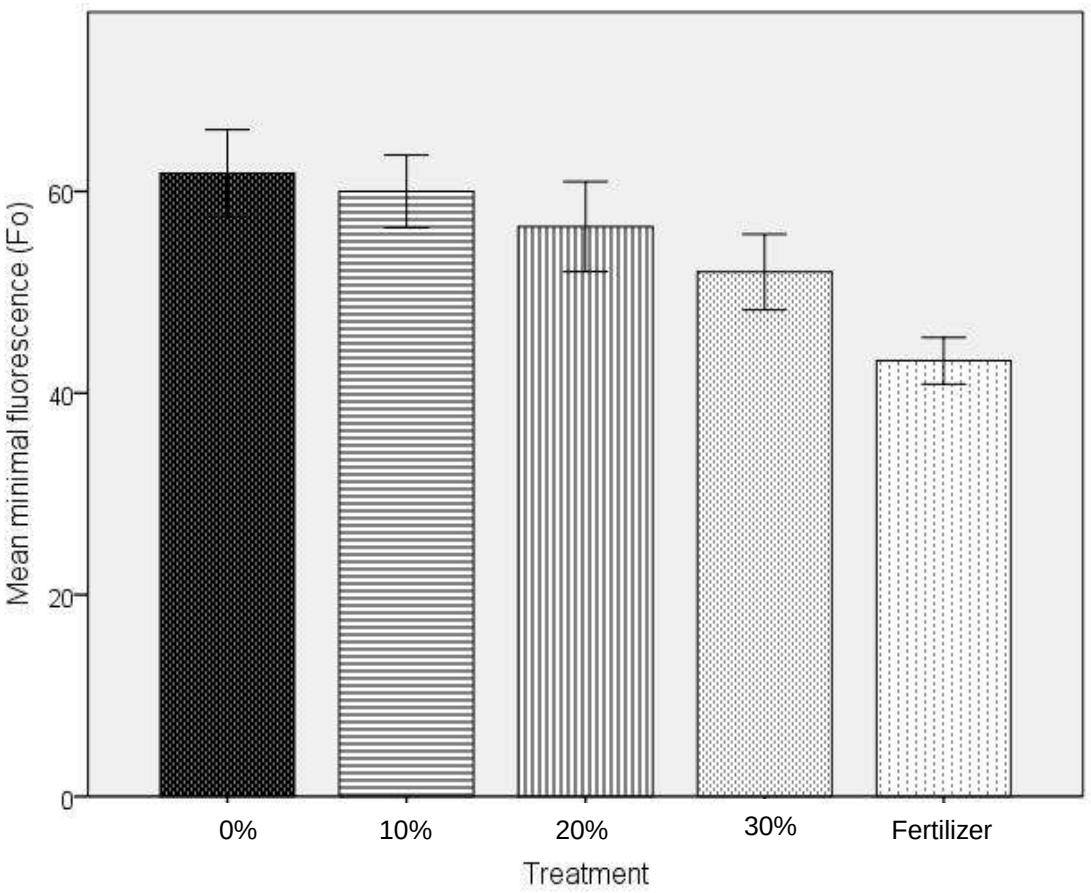


Mean J_{max} of swiss chard

Chlorophyll fluorescence

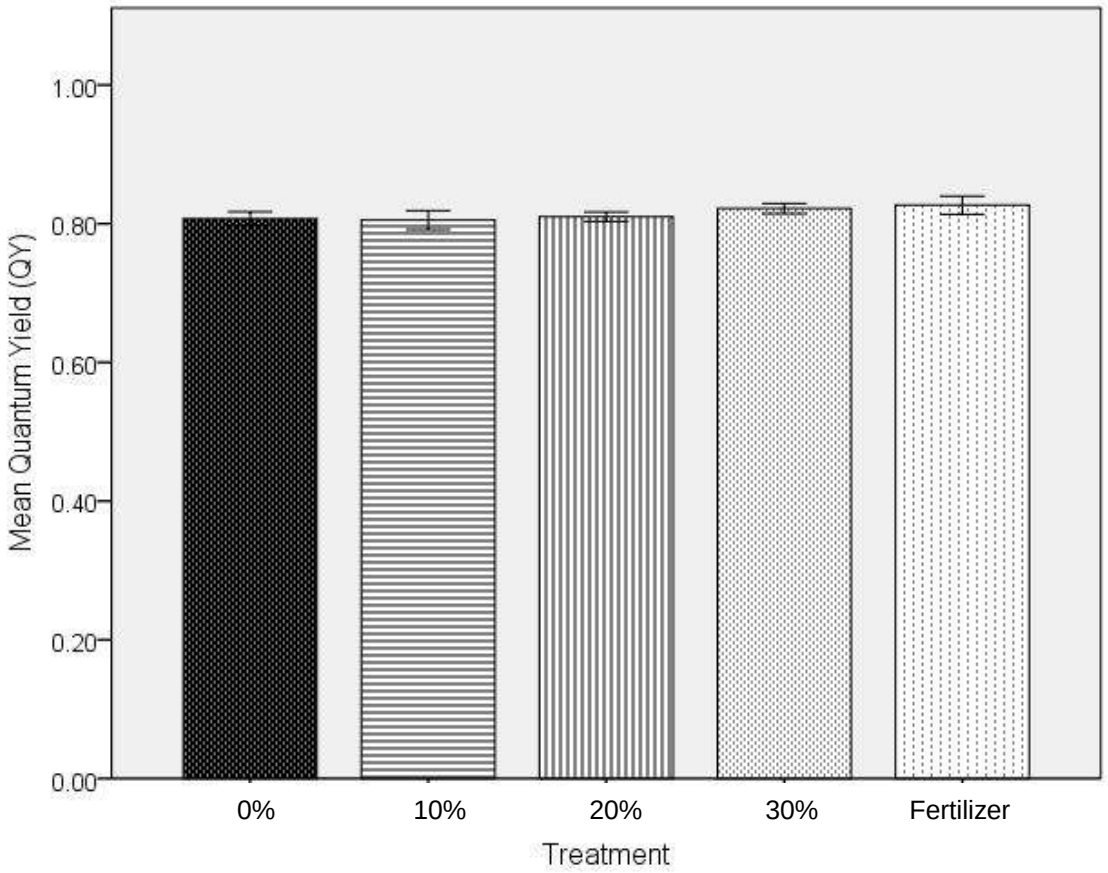
- Commonly used in stress testing
- Light energy can be : 1.) dissipated as heat
  2.) used to drive photosynthesis
  3.) Re-emitted as light energy
- Leaf exposed to light of a specific wavelength

Chlorophyll fluorescence – Swiss chard



Minimal fluorescence (F_o) of swiss chard

Chlorophyll fluorescence – Swiss chard



Quantum yield (QY) of swiss chard

Conclusion

- Sludge application rate is important
- Linear relationships between some variables with respect to application rate

Science, after having long groped about, now knows that the most fecundating and the most efficacious of fertilizers is human manure. The Chinese, let us confess it to our shame, knew it before us. Not a Chinese peasant – it is Eckberg who says this – goes to town without bringing back with him, at the two extremities of his bamboo pole, two full buckets of what we designate as filth. Thanks to human dung, the earth in China is still as young as in the days of Abraham. Chinese wheat yields hundredfold of the seed. There is no guano comparable in fertility with the detritus of a capital. A great city is the most mighty of dung-makers. Certain success would attend the experiment of employing the city to manure the plain. If our gold is manure, our manure on the other hand, is gold. (Hugo, 1862).

References

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