The Influence of Crop Residues and Carbonized Crop Residues on Nitrogen Dynamics

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Nitrogen Immobilization who gets the N?

C:N ratio < 20 = mineralization exceeds immobilization
Net gain of NH_4^+ and NO_3^-

C:N ratio 20 – 30 = **Neither gain or loss**

C:N ratio > 30 = Immobilization exceeds mineralization
Net uptake of NH_4^+ and NO_3^-

Biochar Carbon N immobilization?

Lehmann et al. (2002) and Asai et al. (2009) attributed reduced N uptake to N immobilization caused by the high C/N ratio of biochar

Wardle et al. (2008) reports a net N gain through immobilization

Corn stover biochar

Maximum carbonization temperature 400°C for 0.5h with N_2 carrier gas

Pyrolysis products:
- 33% biochar
- 39% bio-oil
- 27% non-condensable gases

Carbonized vs. un-carbonized crop residues



Tifton loamy sand (Plinthic Acrisols)

Top soil 0-0.2 m: low C content
prior sampling fertilized
223 kg ha^{-1} 9-10-10 NPK
Screened 4mm

Treatment preparation

Soil crop residues (CR) and carbonized CR (CRc) were mixed to increase the SOC content by 0.5, 1 and 2%

1) CR 0.5% 32.9 Mg ha^{-1}

2) CR 1.0% 65.8 Mg ha^{-1}

3) CR 2.0% 131.6 Mg ha^{-1}

3) CRc 0.5% 22.9 Mg ha^{-1}

4) CRc 1% 45.8 Mg ha^{-1}

5) CRc 2% 91.6 Mg ha^{-1}

Characteristics of CR and CRc

	C	N	P	K	C/N
	----------------g kg^{-1}----------------				
CR	425.63	5.98	0.85	2.10	71.19
CRc	612.37	12.50	2.50	5.80	48.99

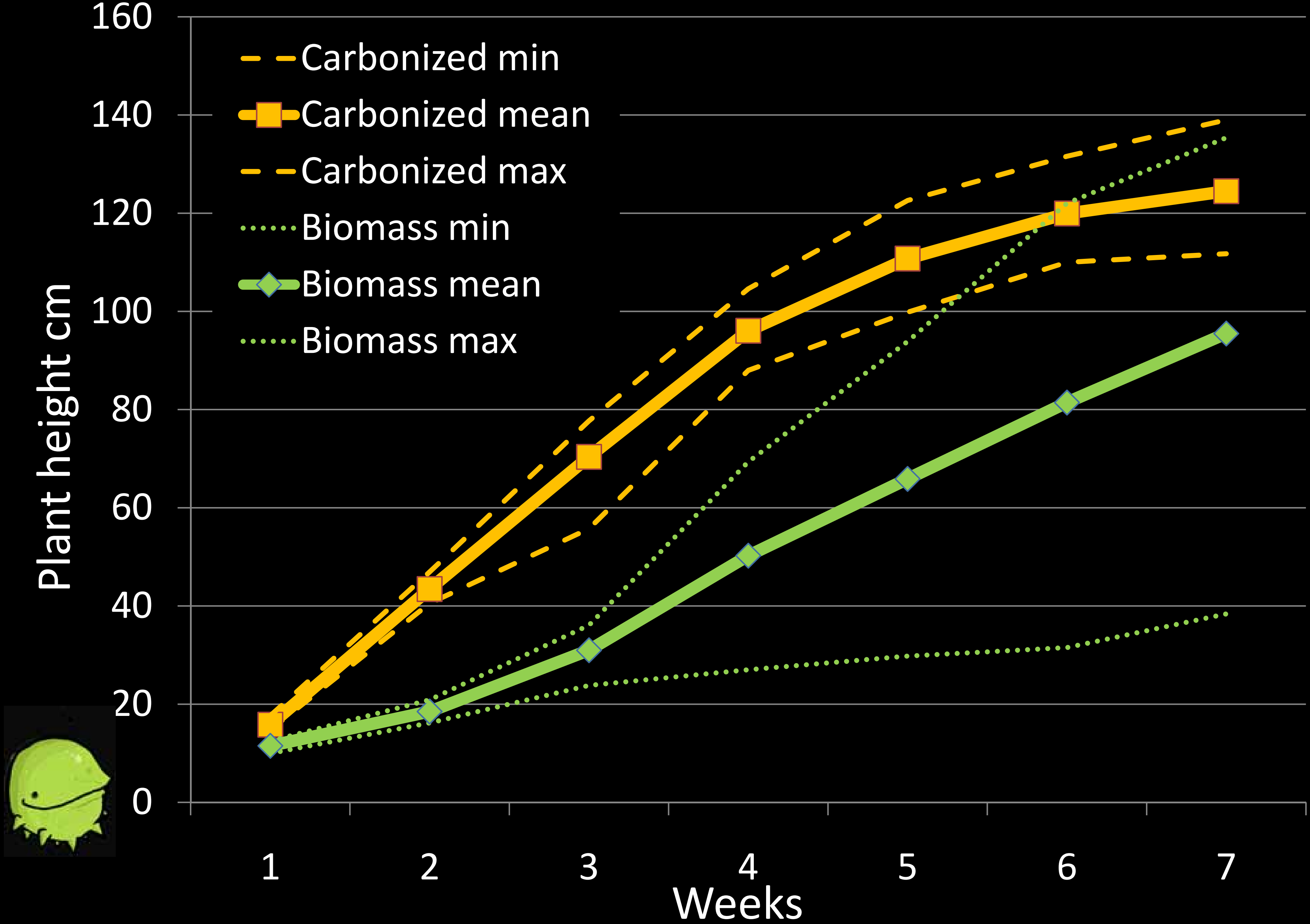
Greenhouse setup



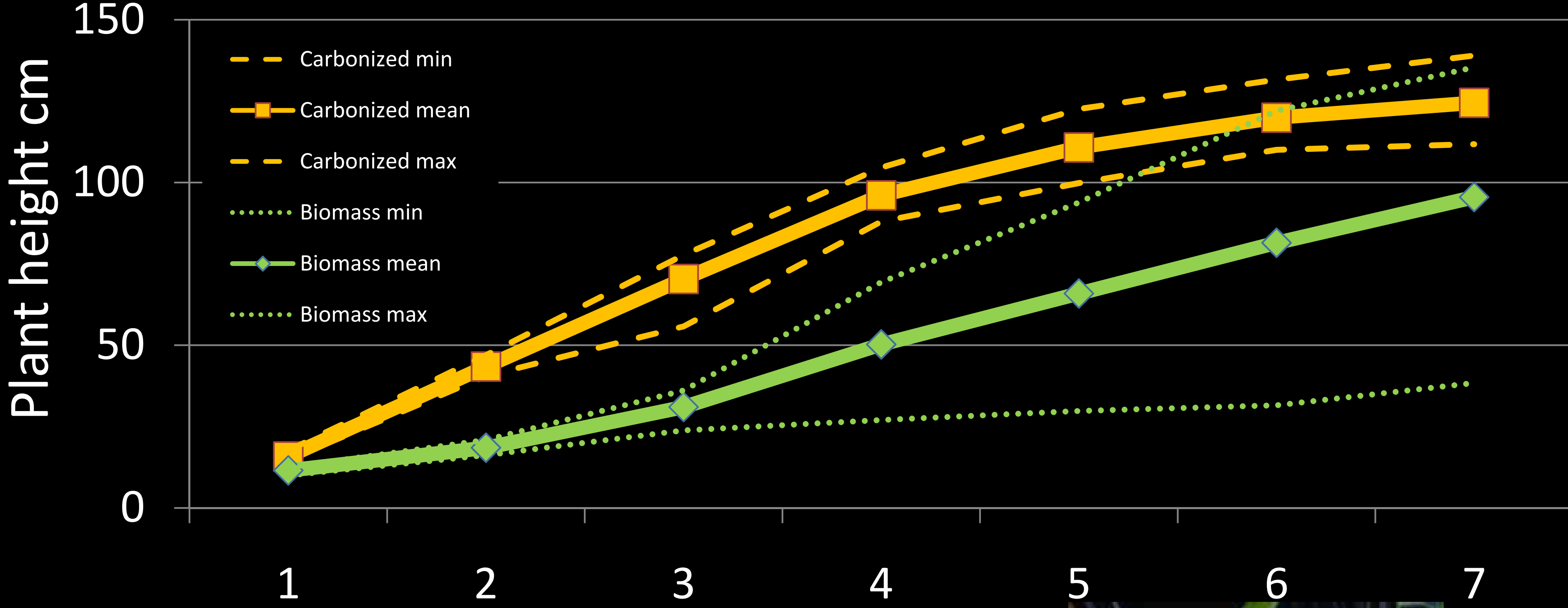

- Randomized complete block design with 4 replicates
- 4 seeds of corn (*Zea mays*) planted and reduced to 1 (after one week)
- Fertilization: 83kg ha^{-1} K_2SO_4 (37.2 kg ha^{-1} K and 15.3 kg ha^{-1} S)
  Nitrogen at 40, 80, and 160 kg ha^{-1} as NH_4NO_3
  Micronutrients (Scotts) 13 kg ha^{-1}

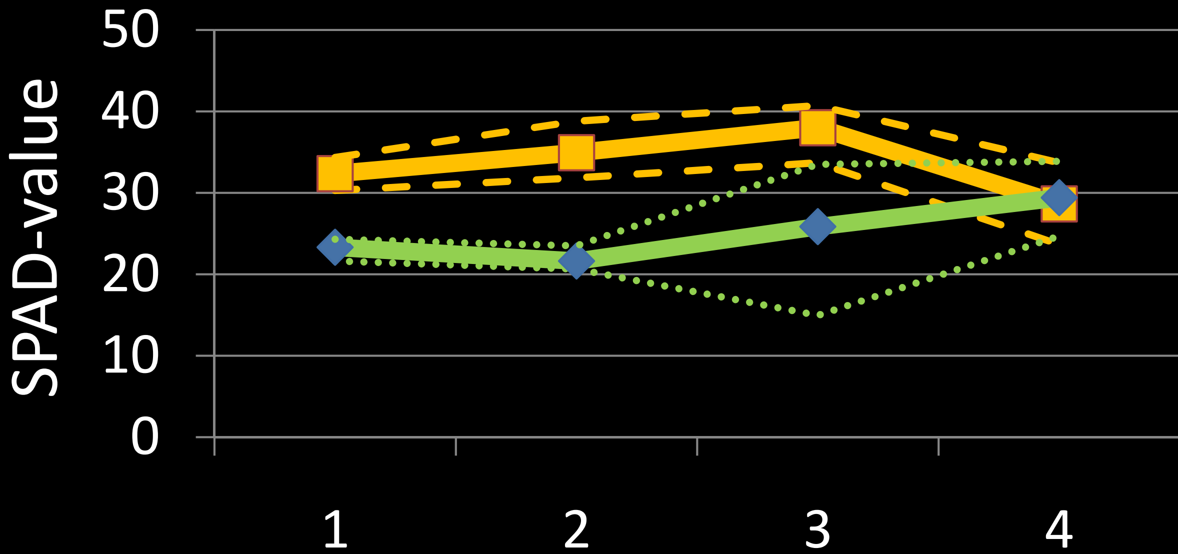
→ 3 levels of C from two different sources and 3 levels of N

Results plant growth

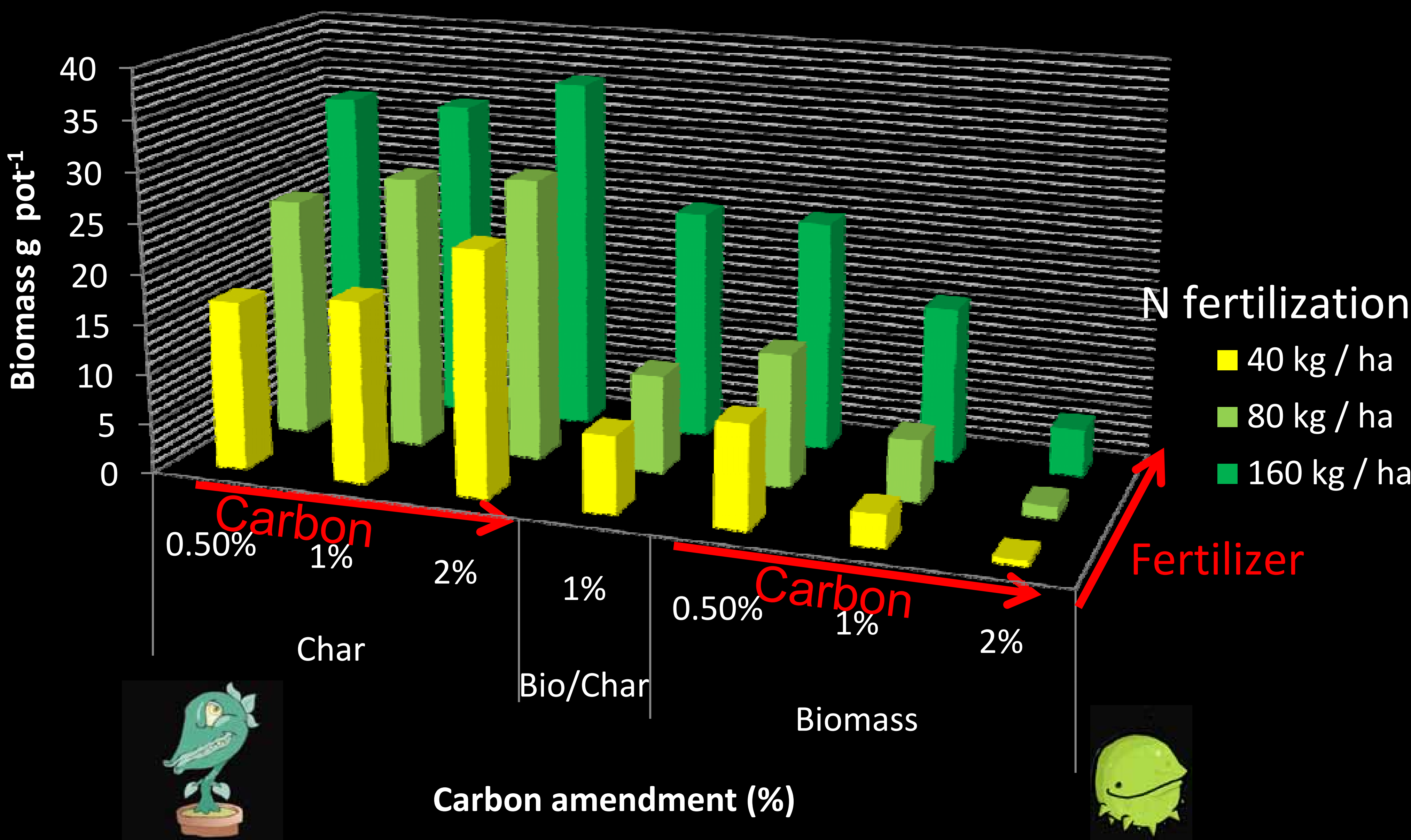


Results plant growth and chlorophyll concentration (SPAD-value)

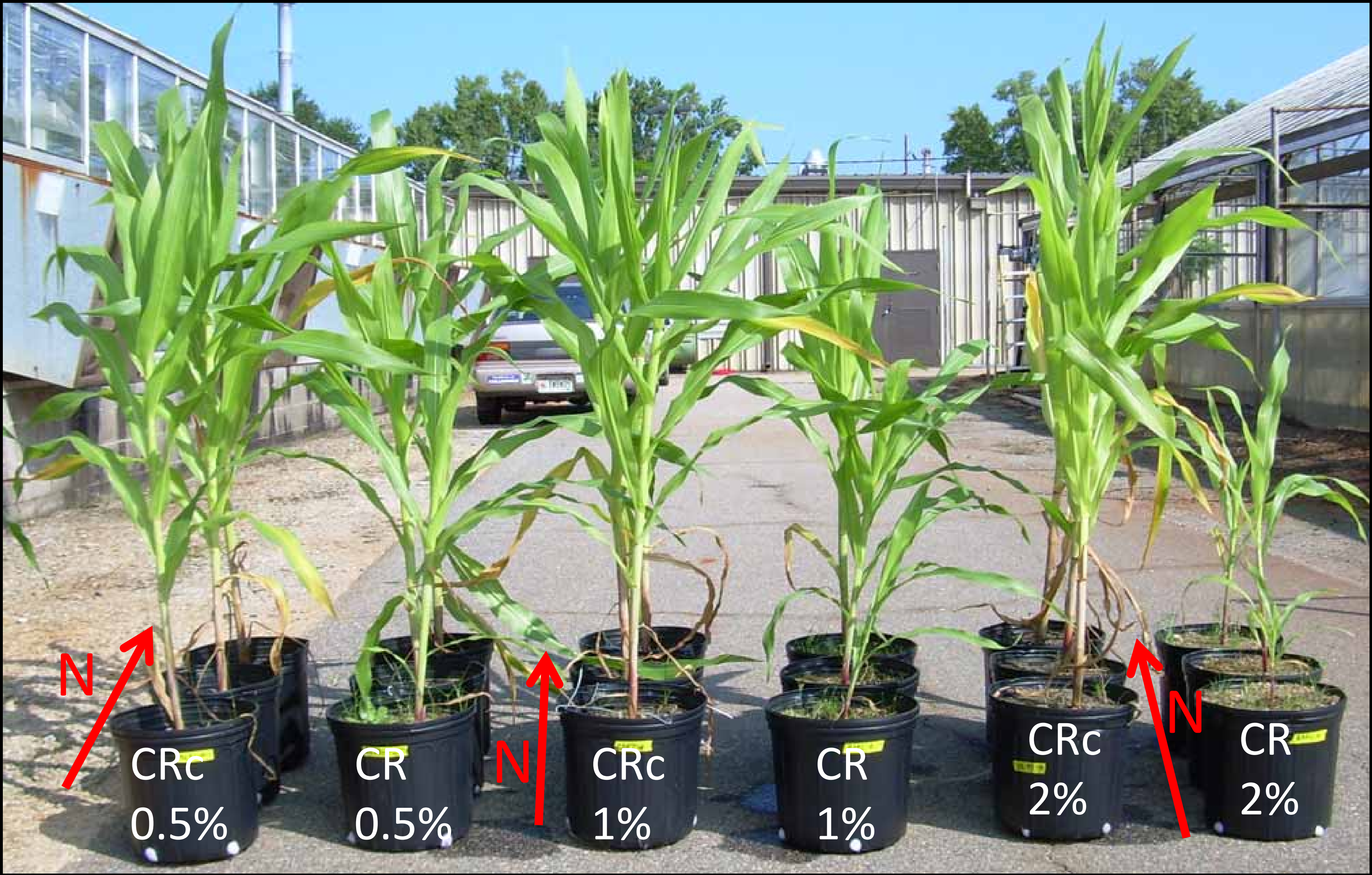




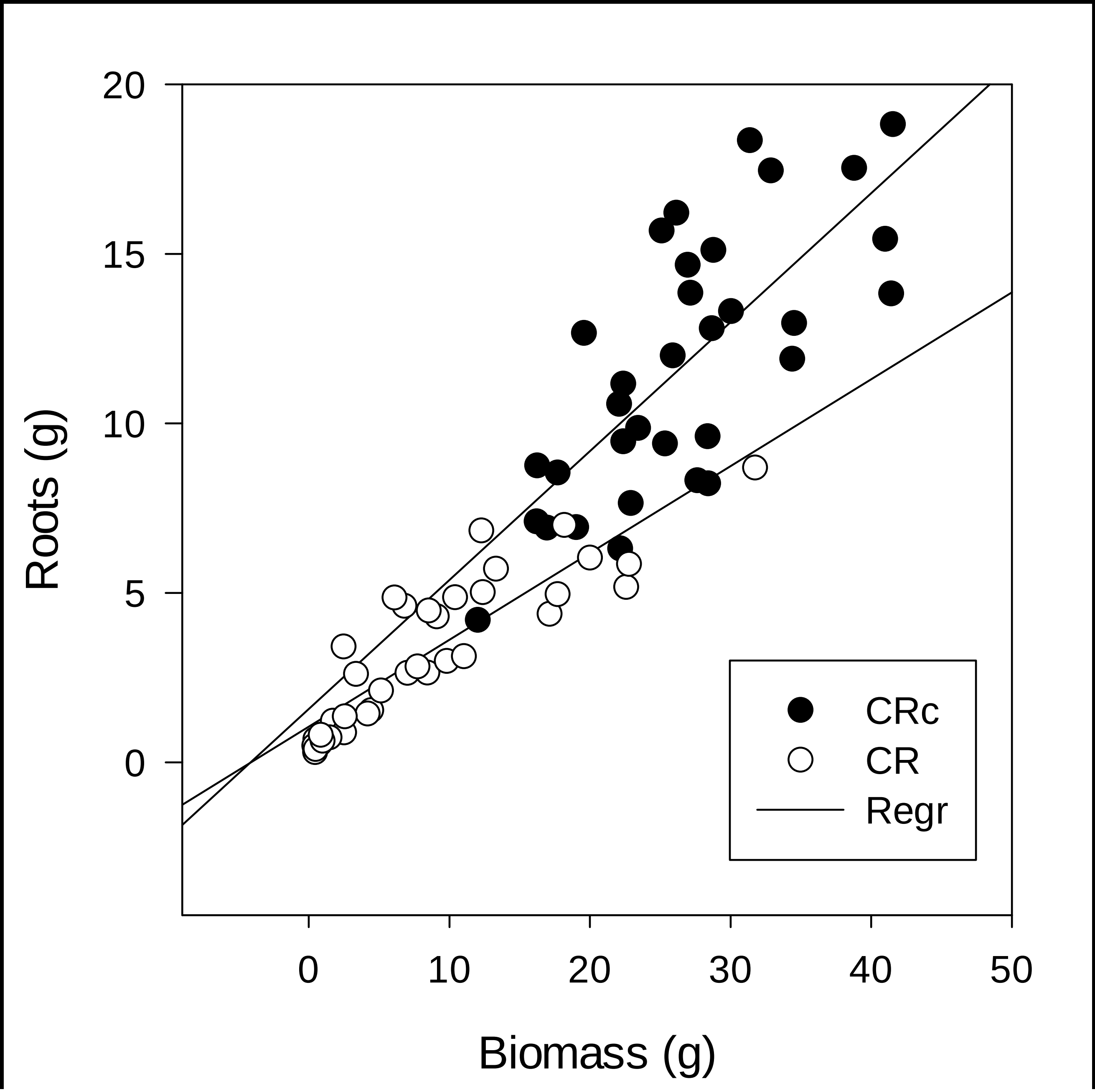
Results biomass at harvest 7 weeks (at tasseling stage)



Results biomass at harvest 7 weeks (at tasseling stage, Block A)



Results aboveground biomass vs. belowground biomass



CRc regression

CR regression

Results biomass at harvest 7 weeks (at tasseling stage, Block A)