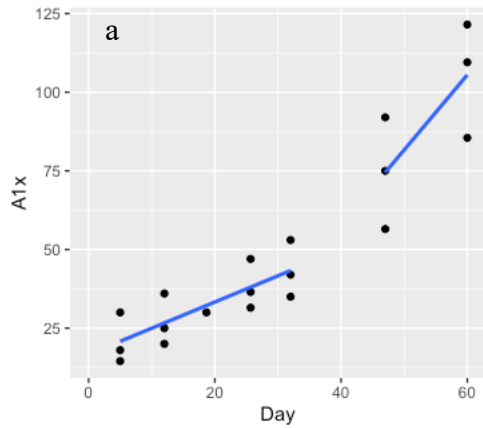


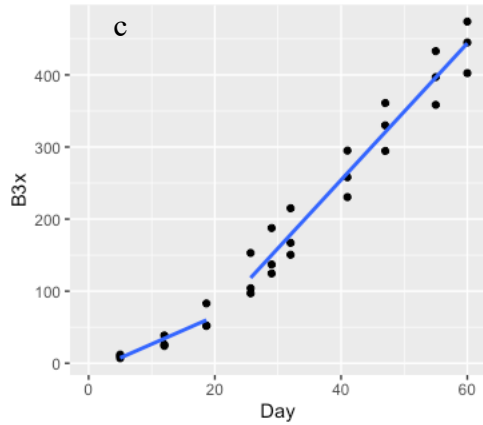


Supplemental Figure S1. Typical sampling setup (All Experiments). A gas tight syringe was inserted first, relieving the excess pressure and recording the volume of biogenic gas produced. With the pressure was equalized to 1 atmosphere, a separate syringe was used for gas and liquid sampling. If desired, an inert gas (e.g. nitrogen) may be injected into the headspace, up to the gas tight syringe volume, prior to sampling. The experiment was performed in 1-liter jars (left) and we used the same gas and liquid sampling technique shown here with in 40 mL VOA vials (right). The liquid height in the jars was sufficient for liquid sampling with a 3" syringe.

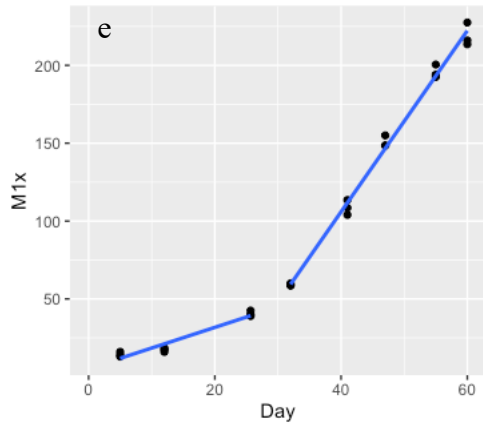
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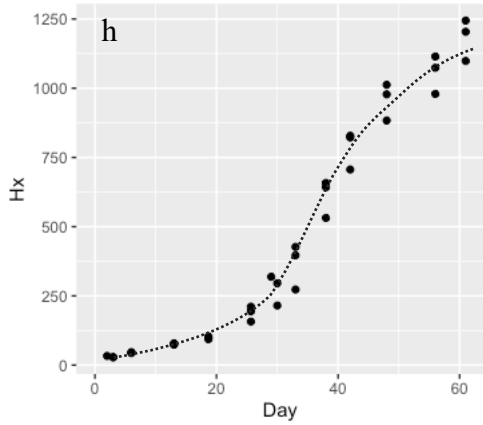
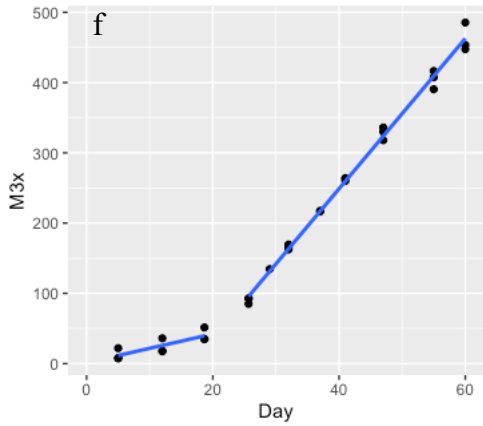
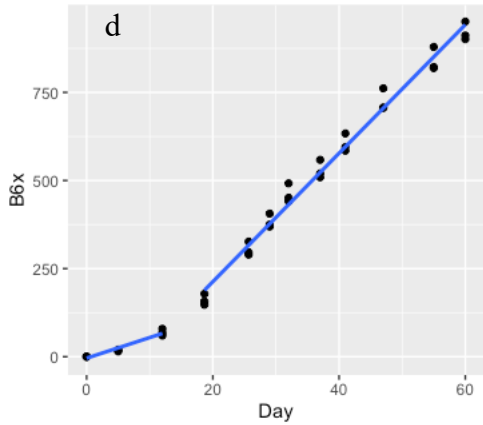
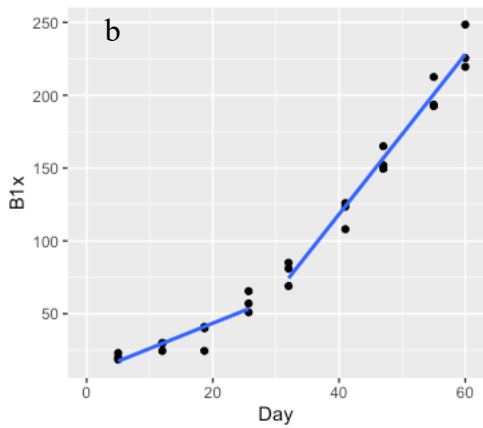
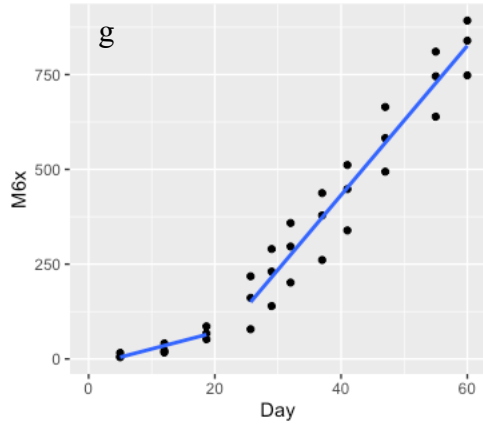
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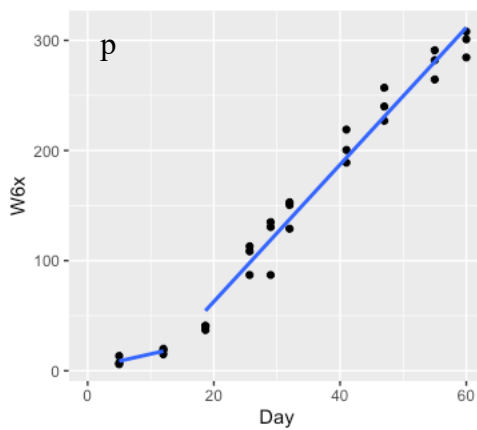
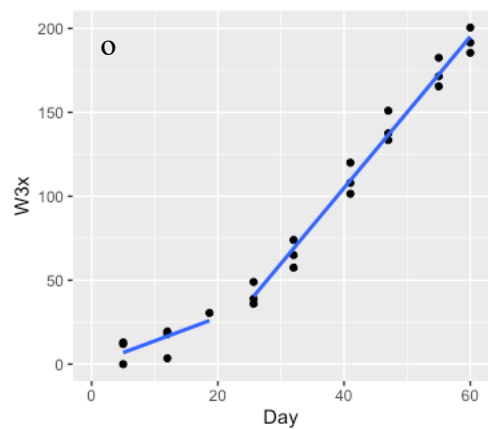
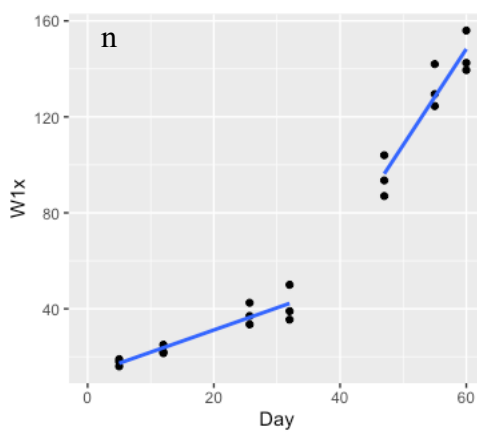
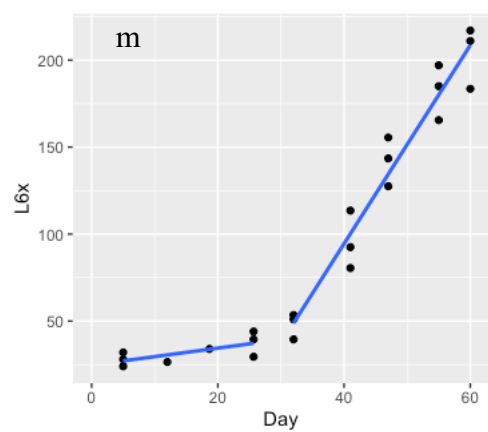
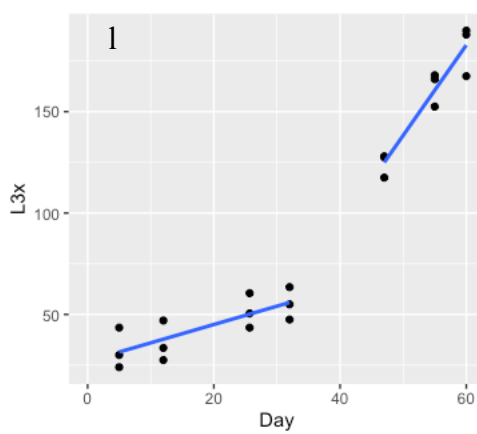
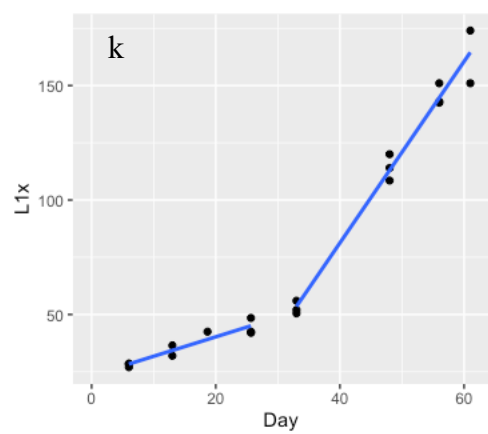
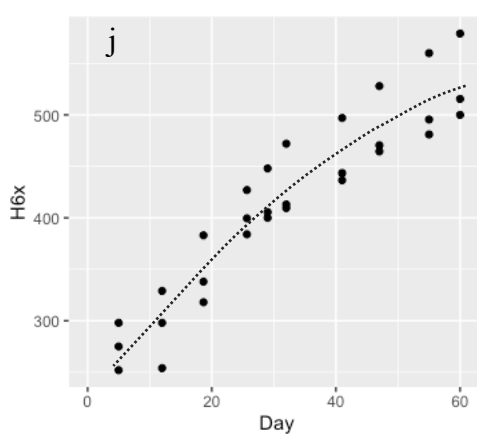
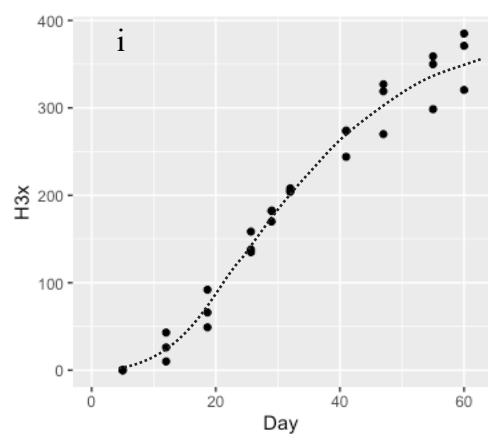
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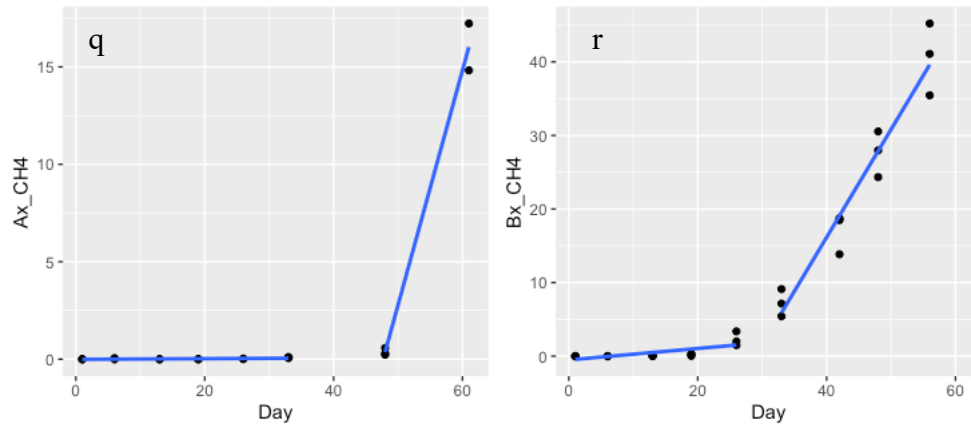
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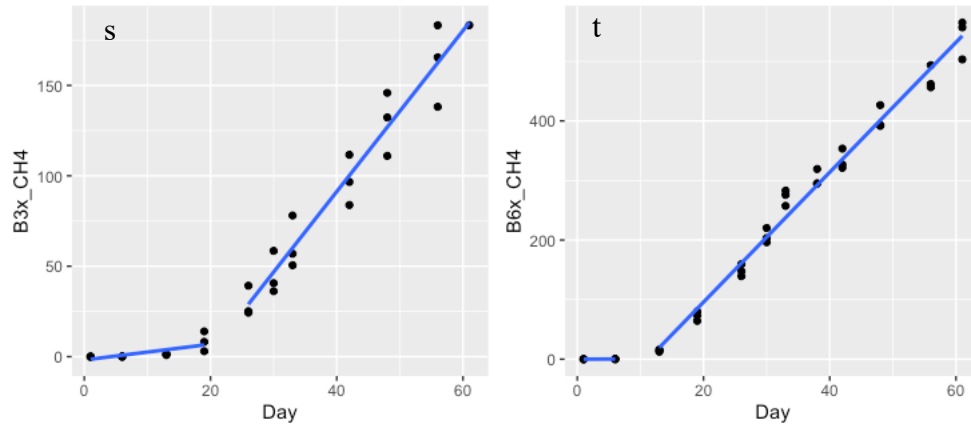
Supplementary Figures S2 (SCL) & S3 (SL). Experiment 1. Microcosm incubations gas production with time. The vertical axes represent cumulative total gas produced in cubic centimeters. Lines represent linear functions generated with the Segmented R function, except hay (H#x) which used sigmoidal curves generated with the SSgompertz R function. Graphs with orange (not blue) lines indicate instances where Segmented was not able to assign dual linear functions. Segmented breakpoints were based on total gas curves, except Figures S4b, h, & n, where methane curves (Figures S4r, x, & dd) were used.



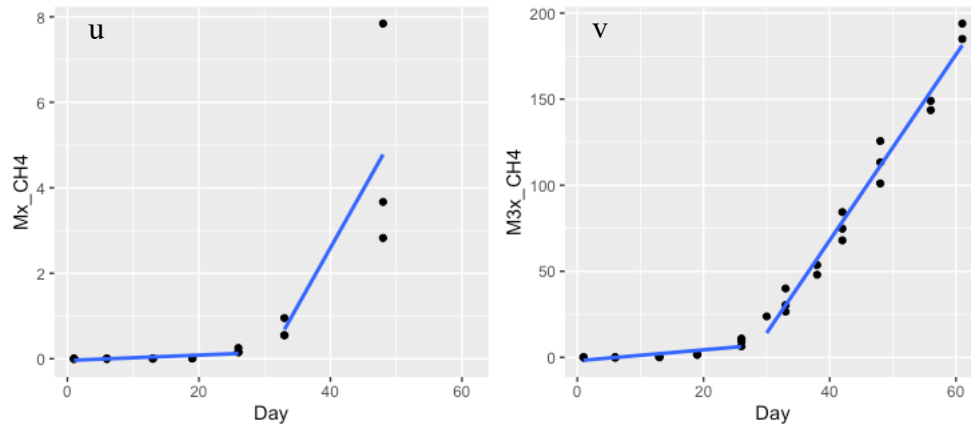
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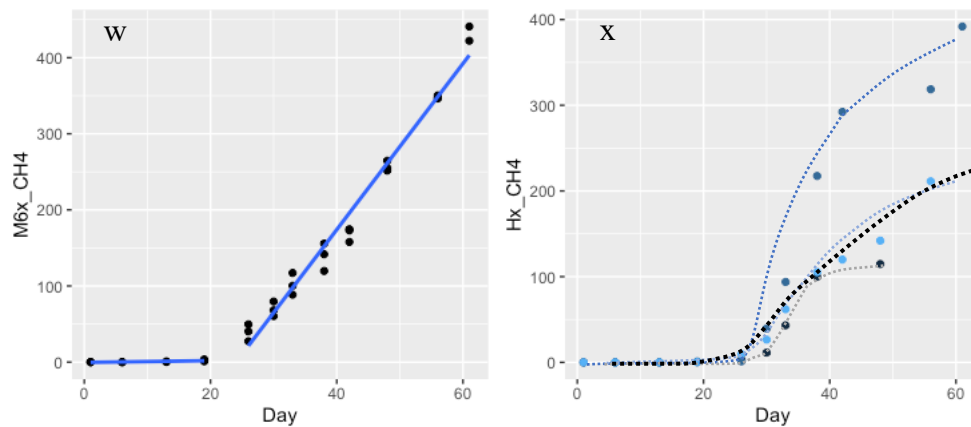
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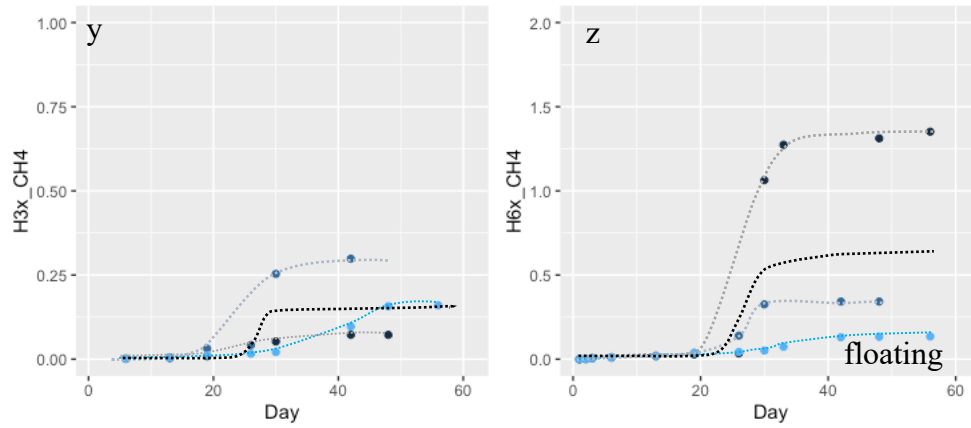
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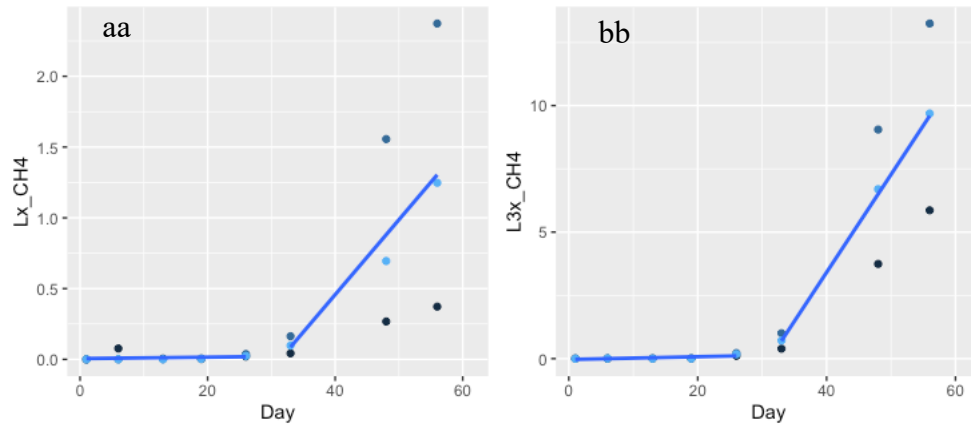
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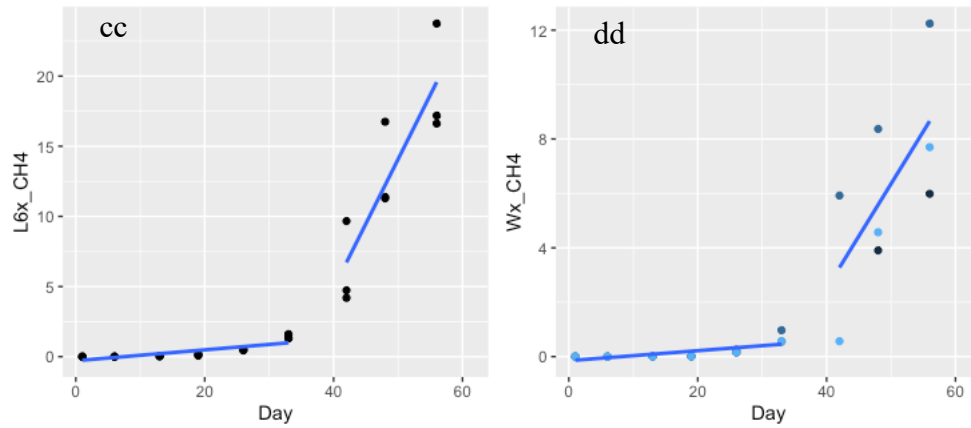
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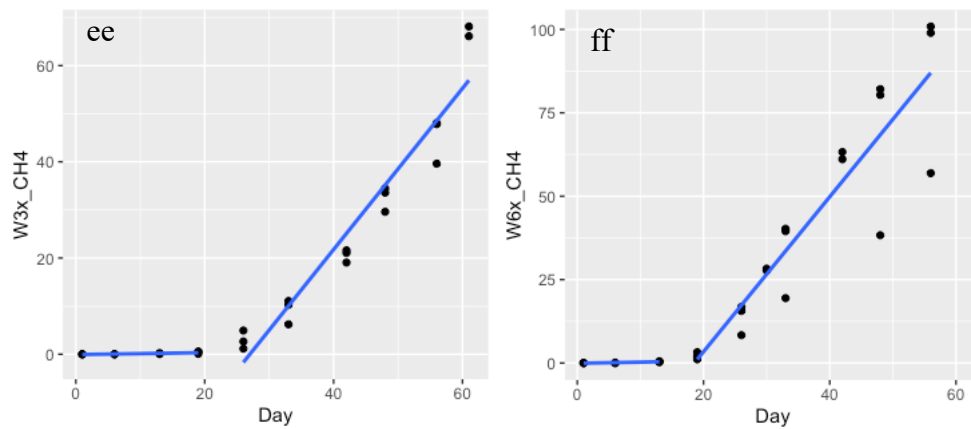
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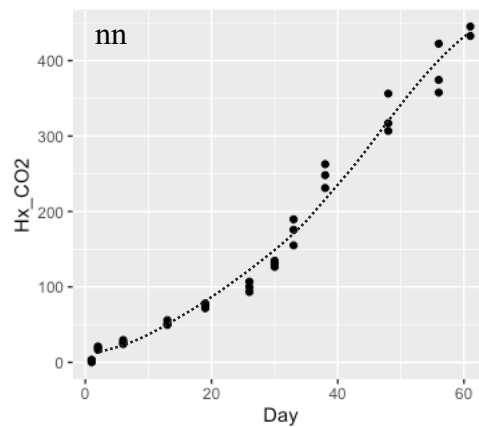
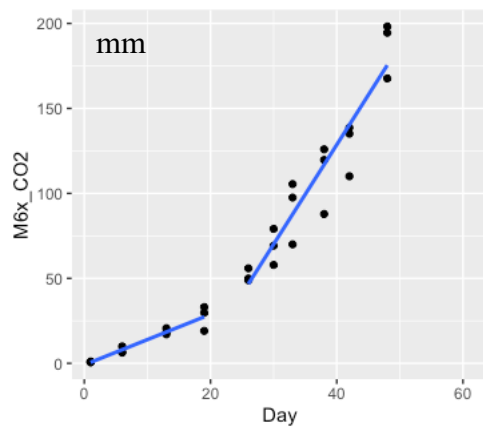
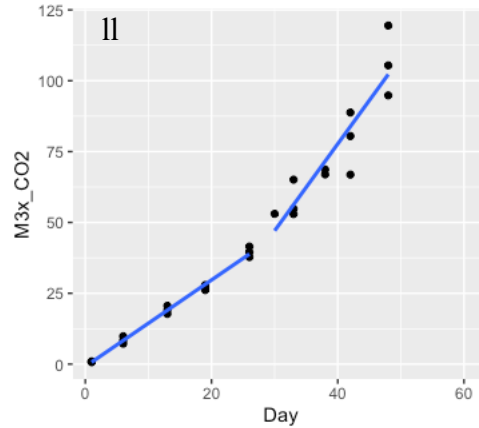
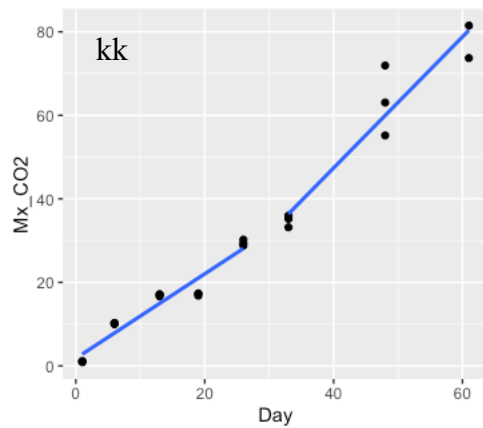
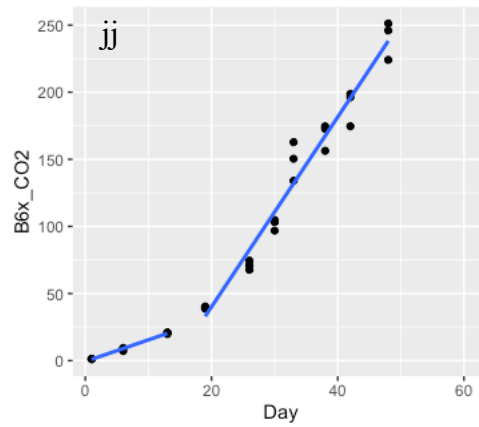
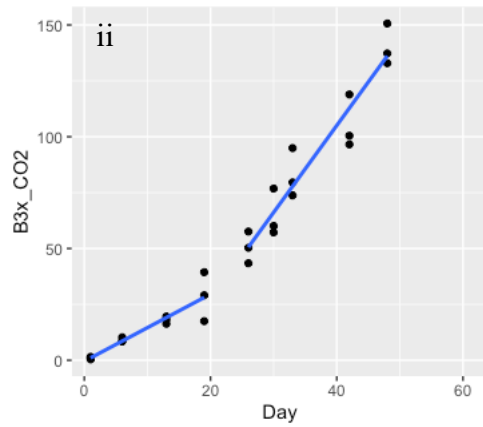
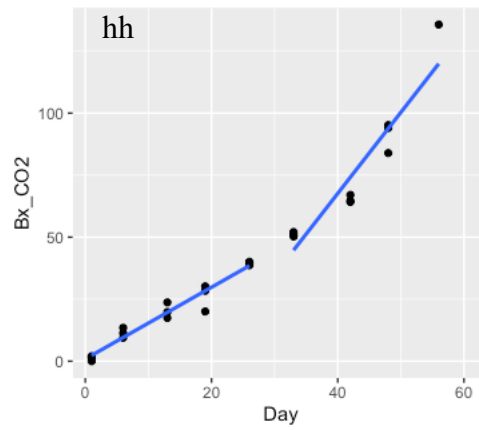
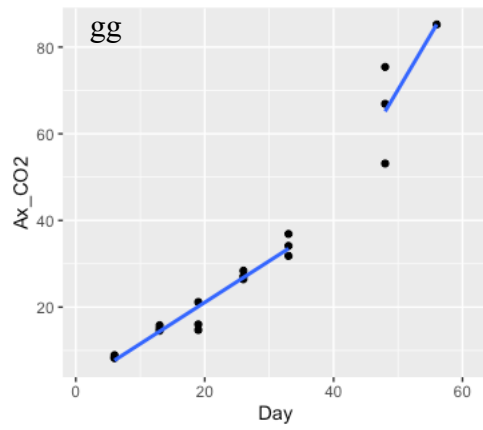
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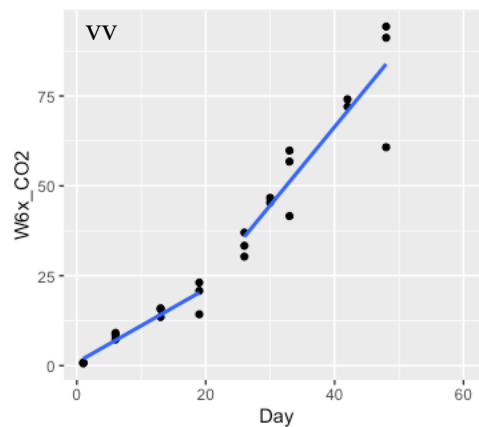
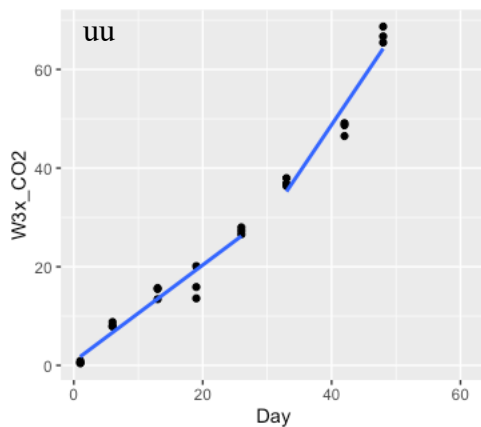
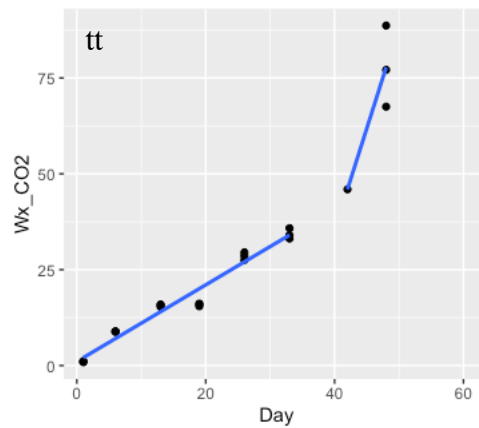
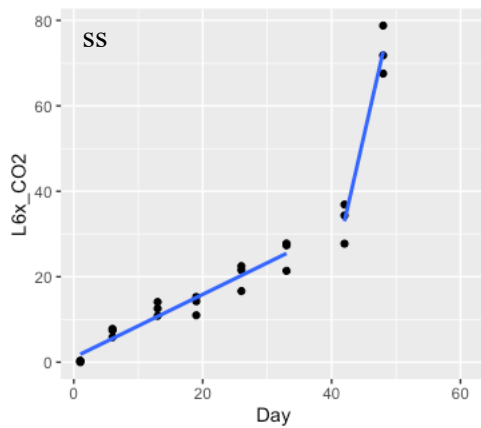
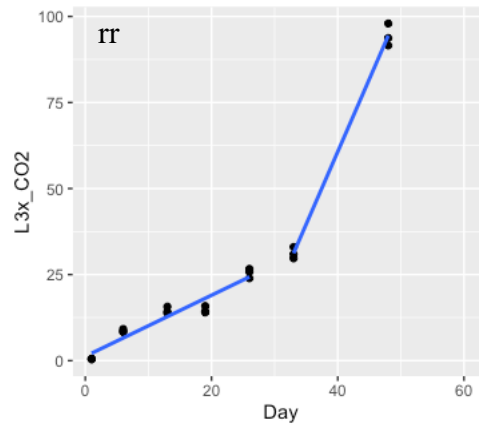
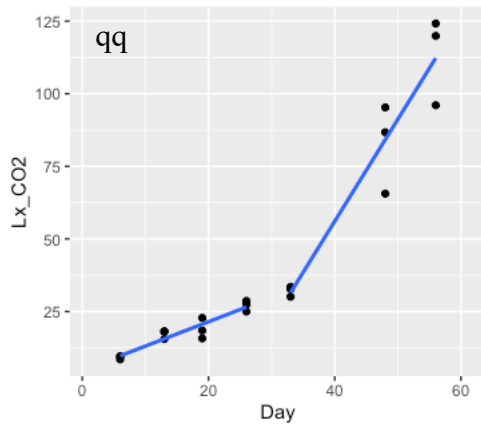
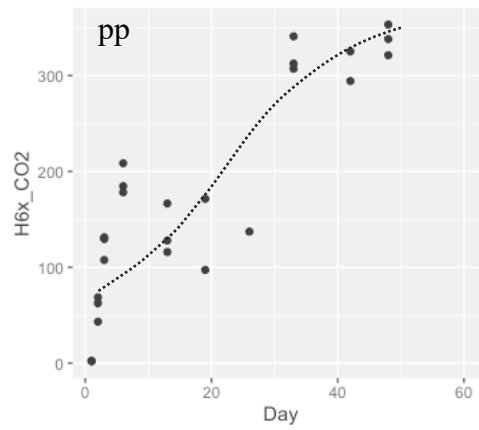
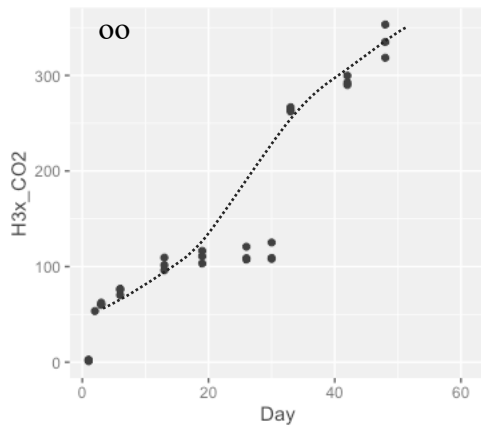


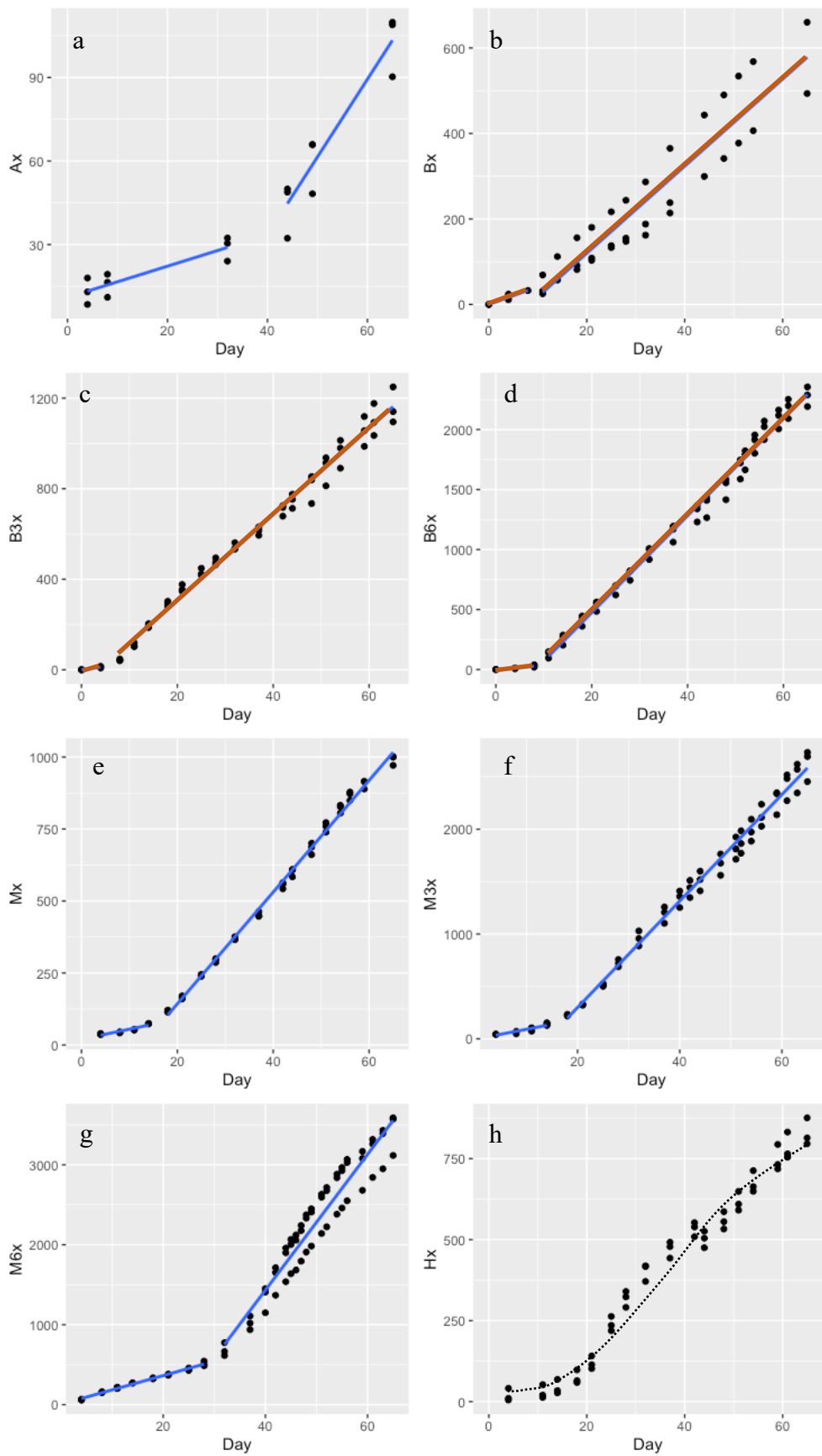
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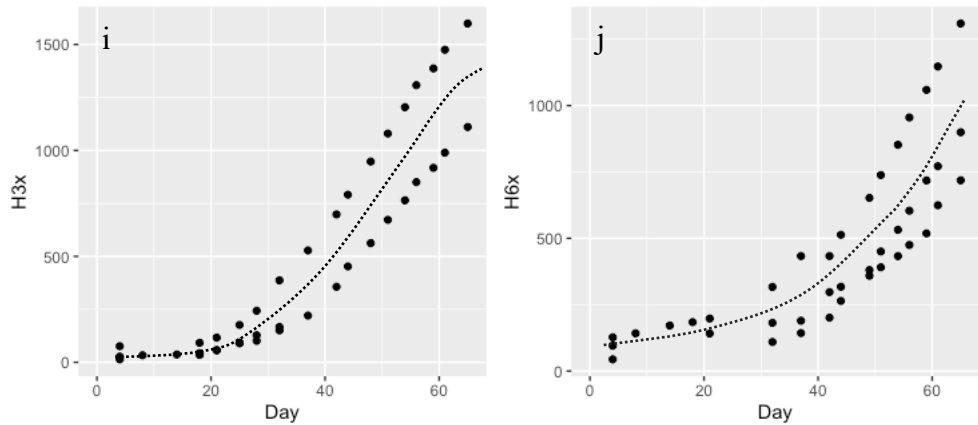
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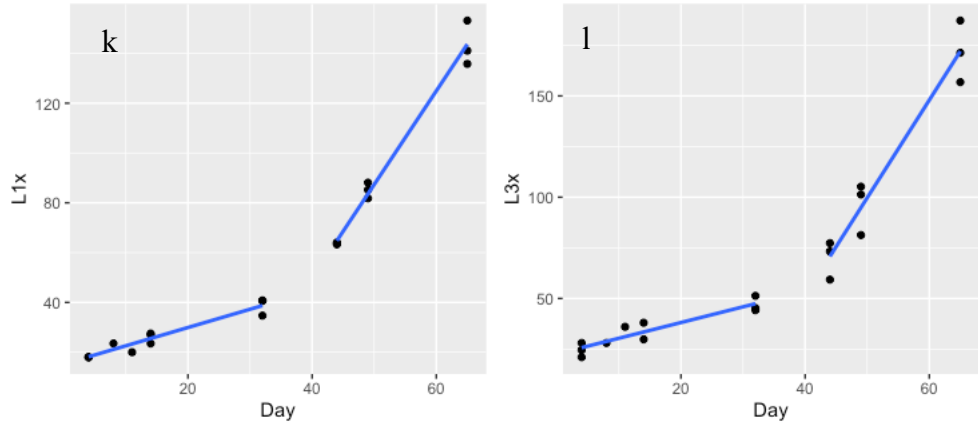
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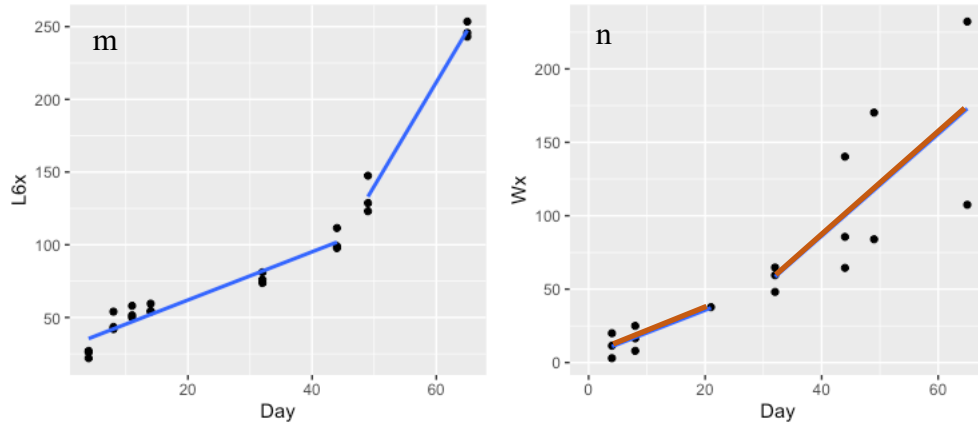
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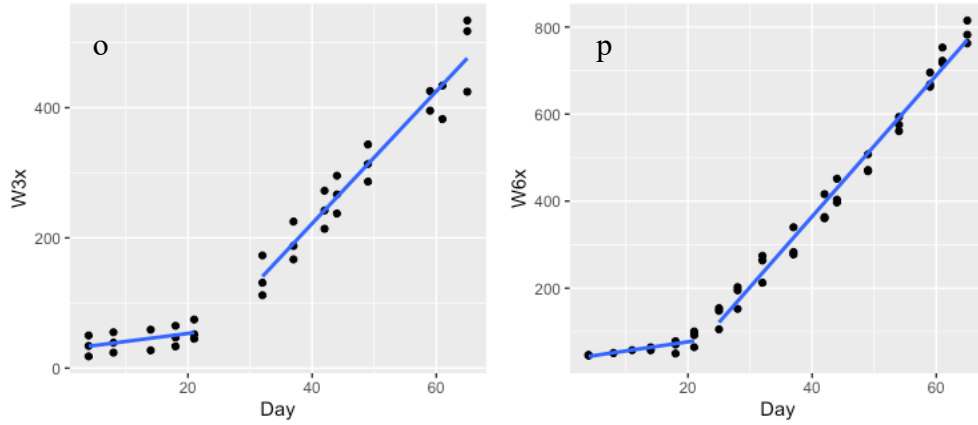
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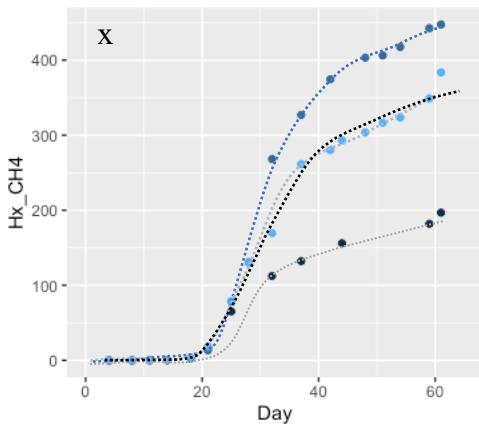
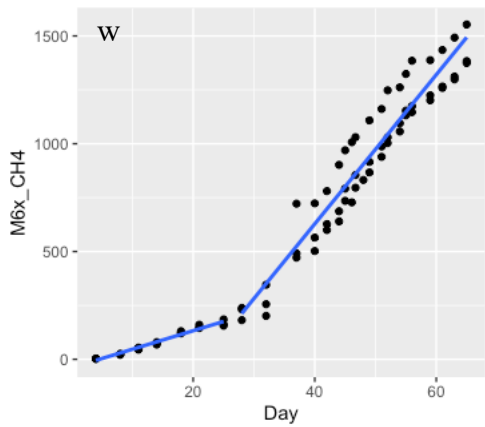
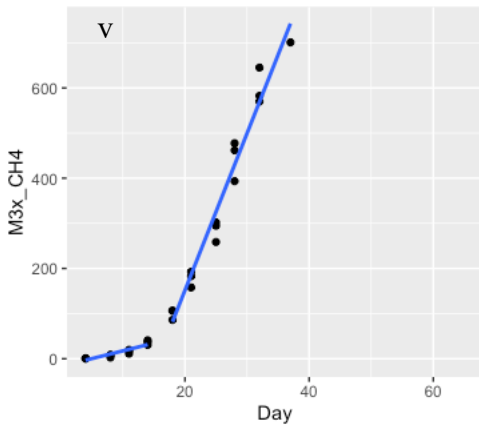
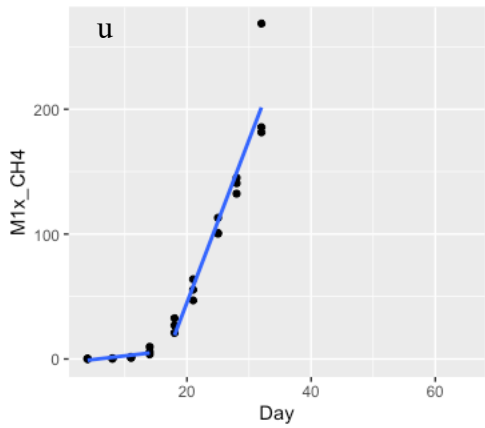
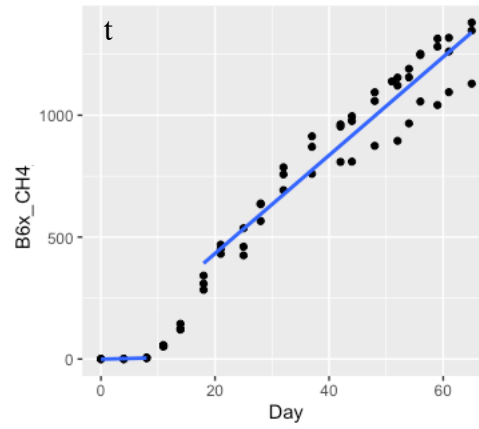
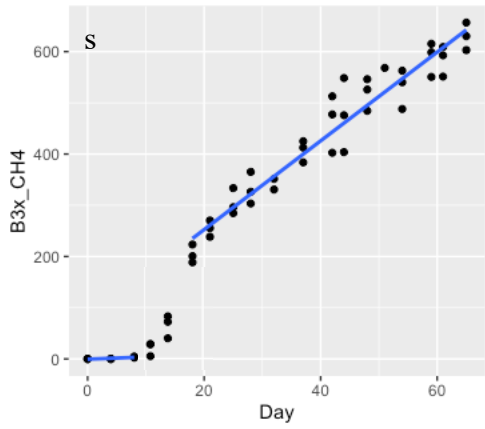
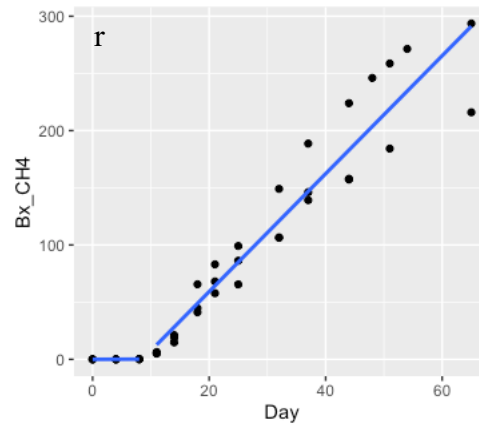
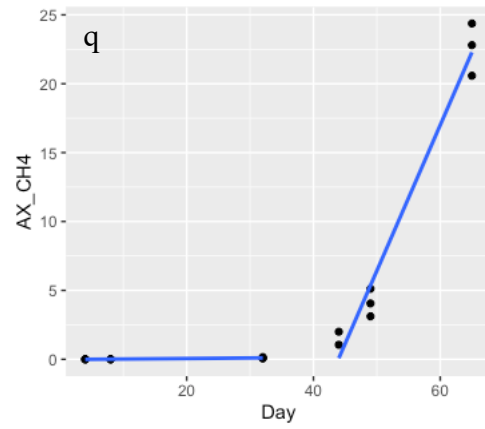


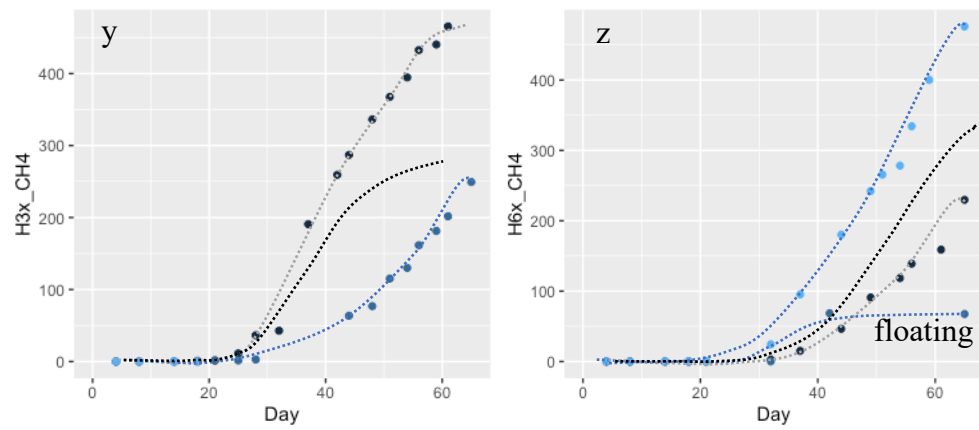
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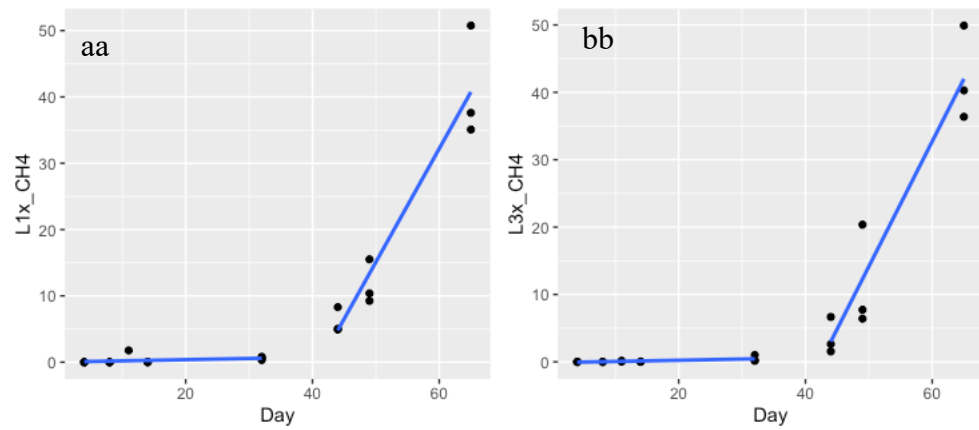
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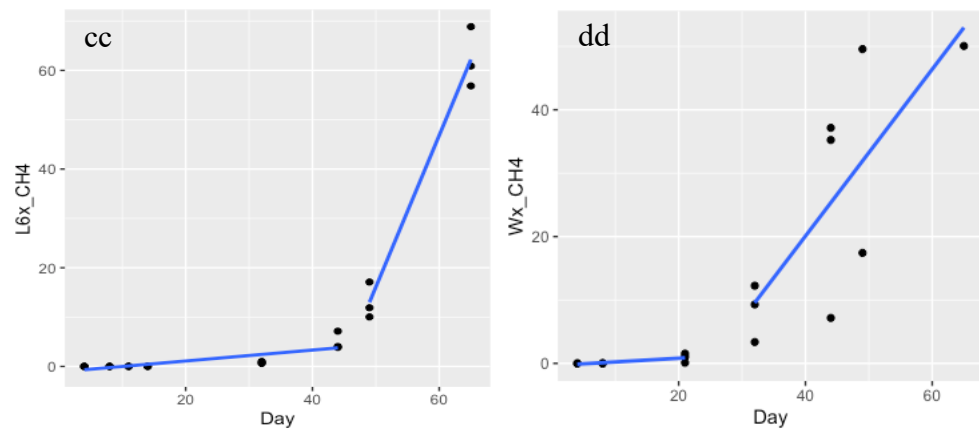




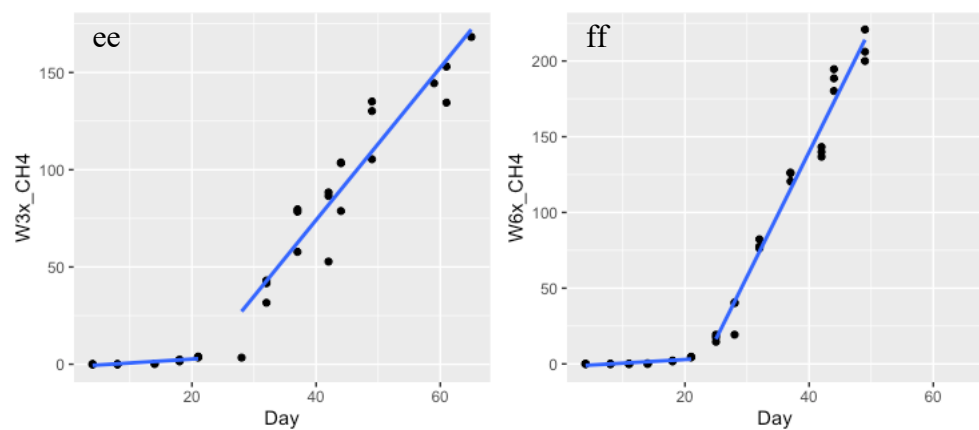
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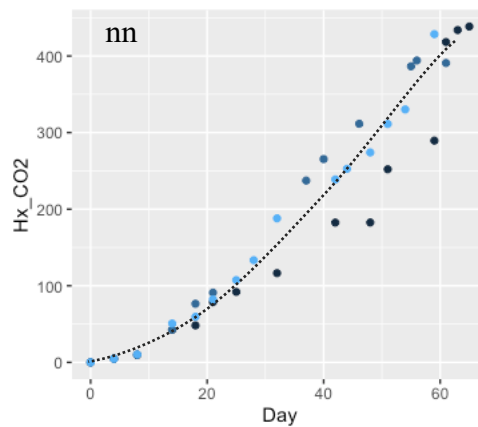
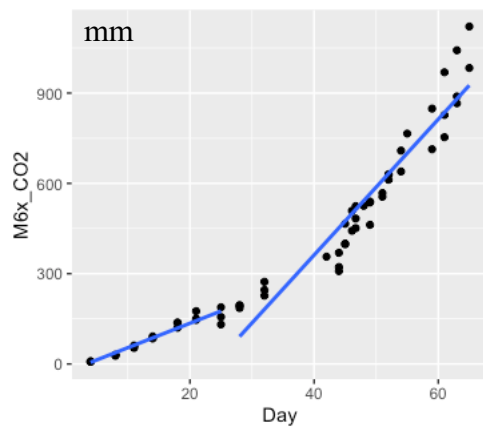
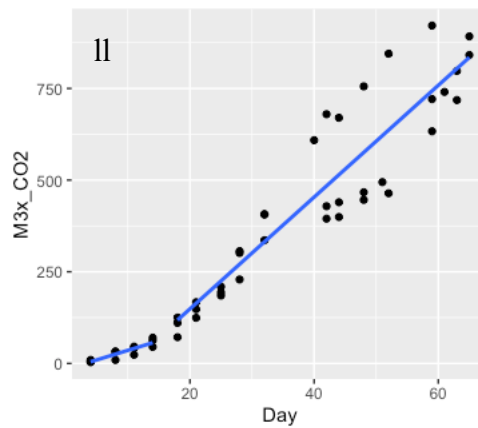
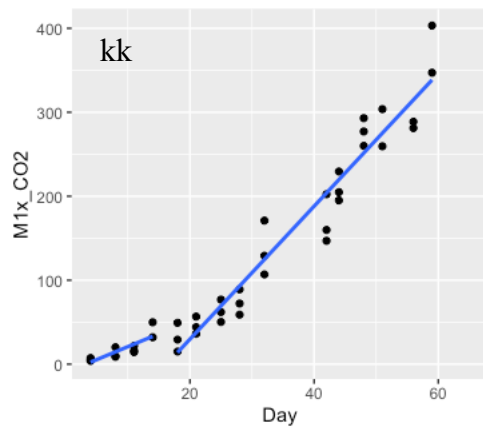
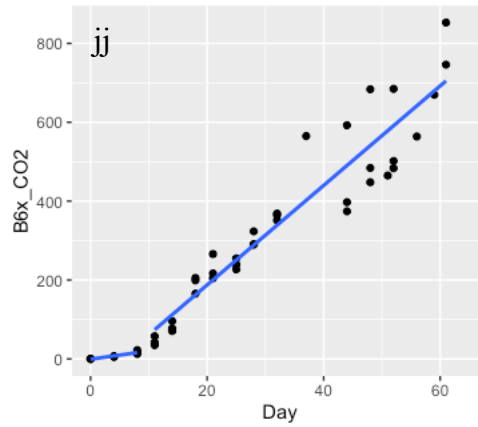
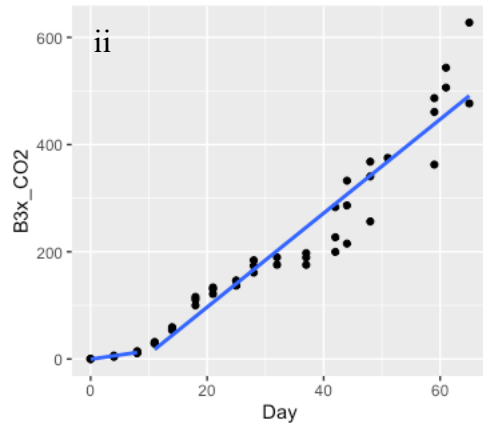
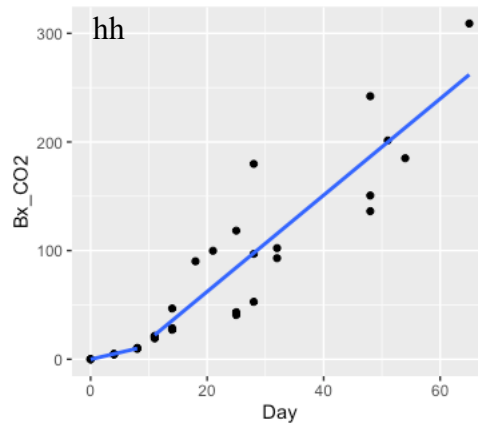
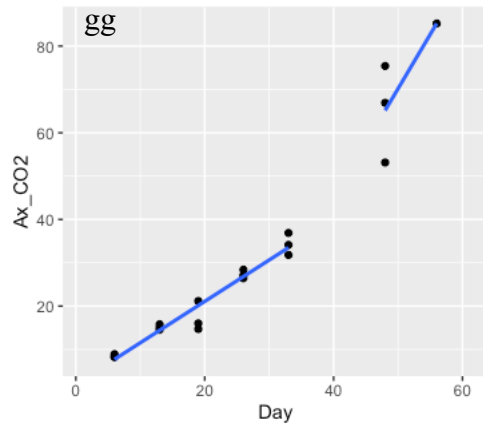
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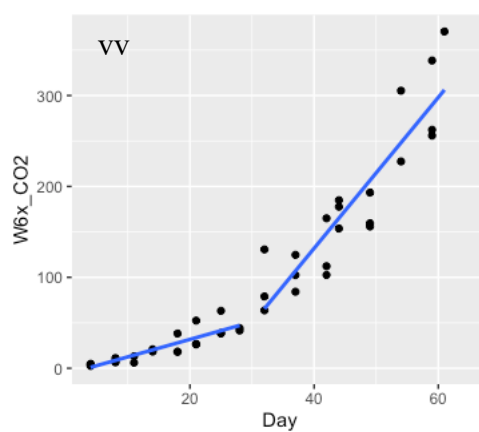
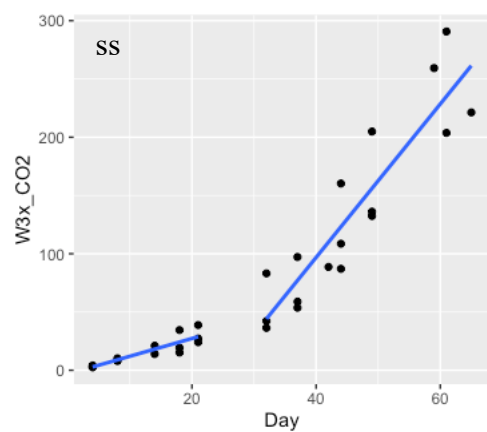
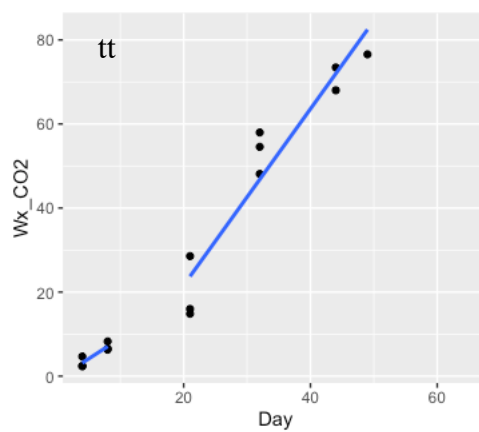
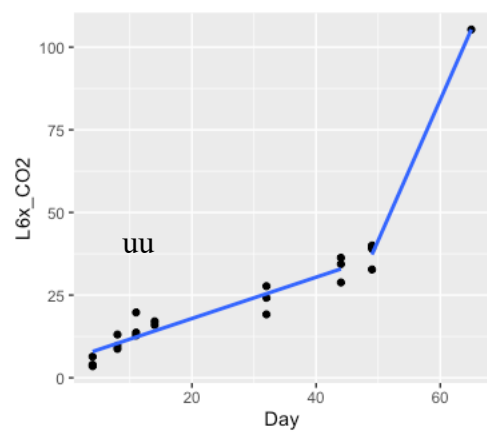
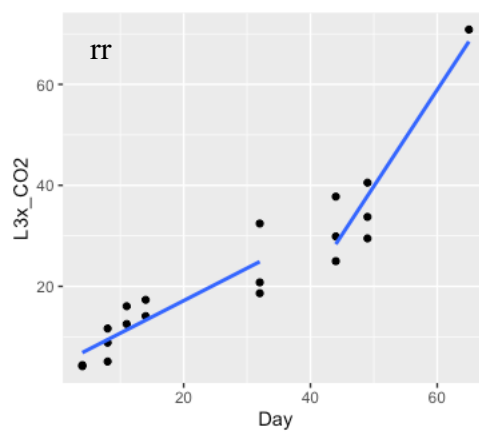
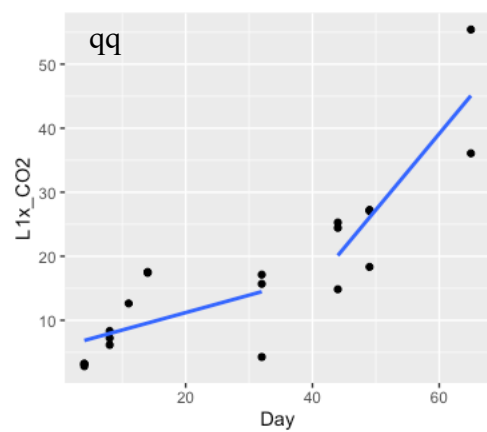
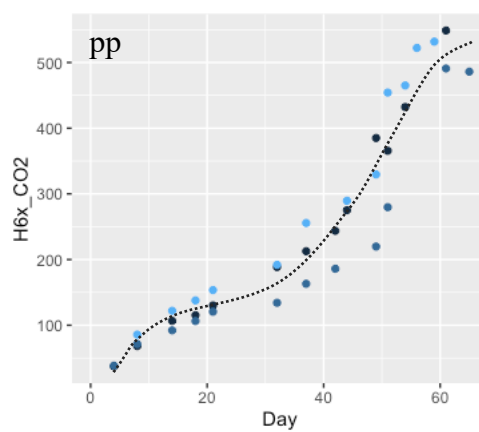
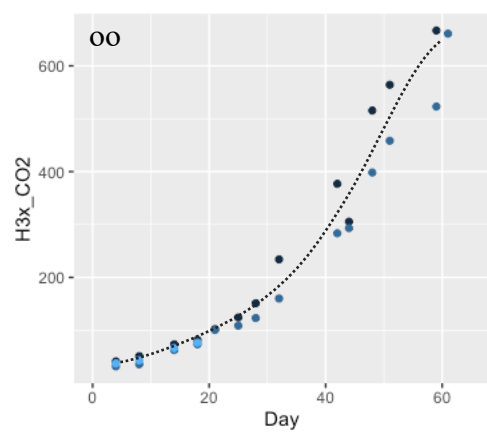


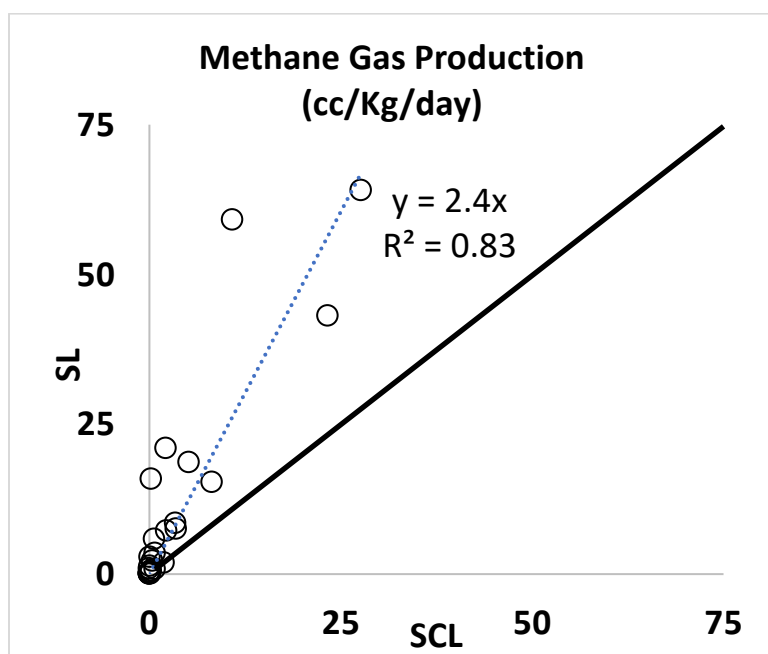
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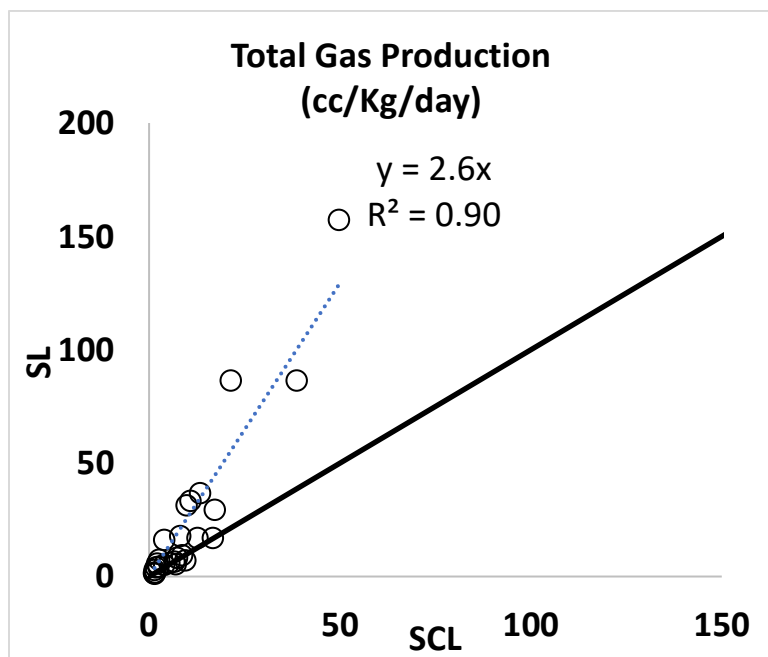
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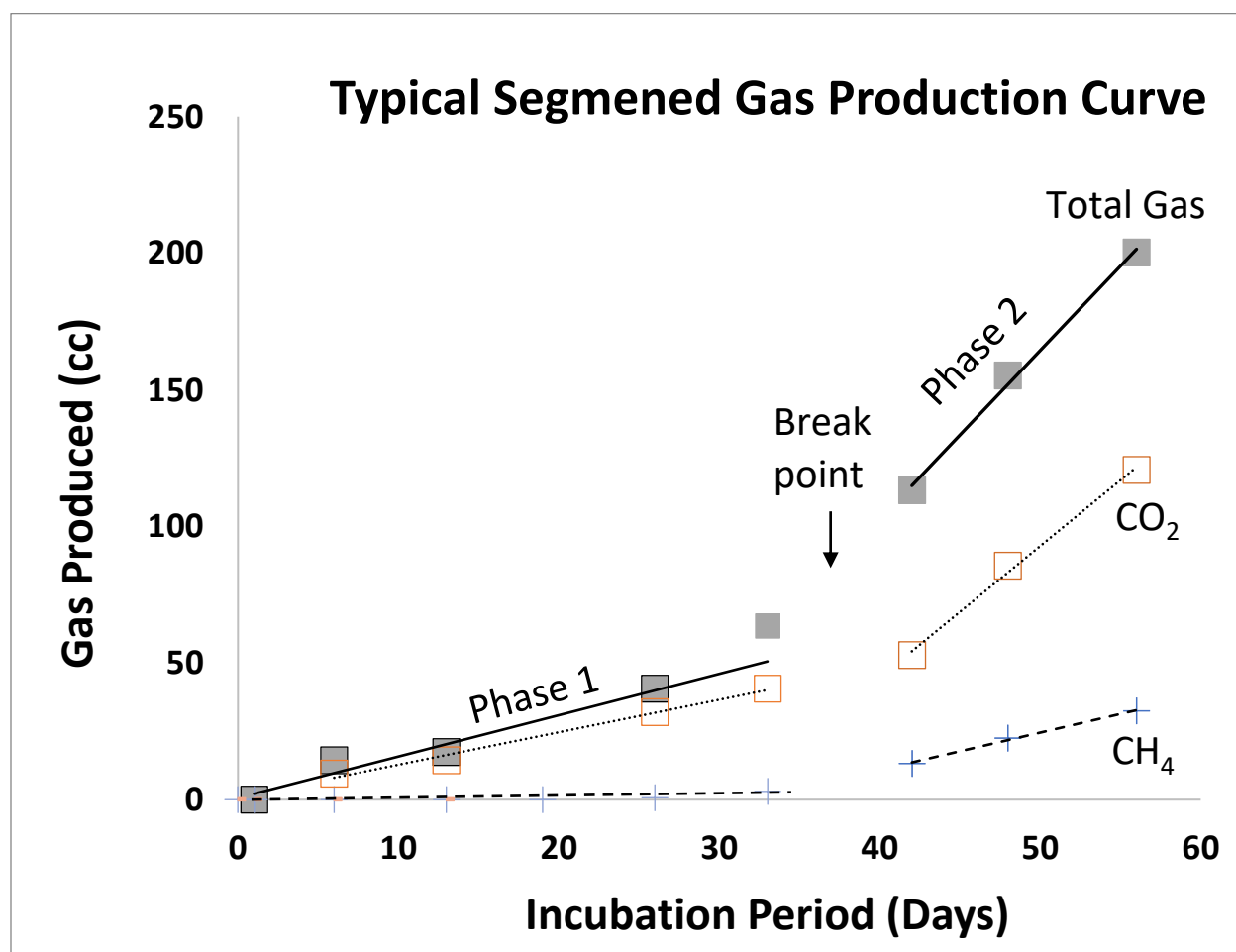




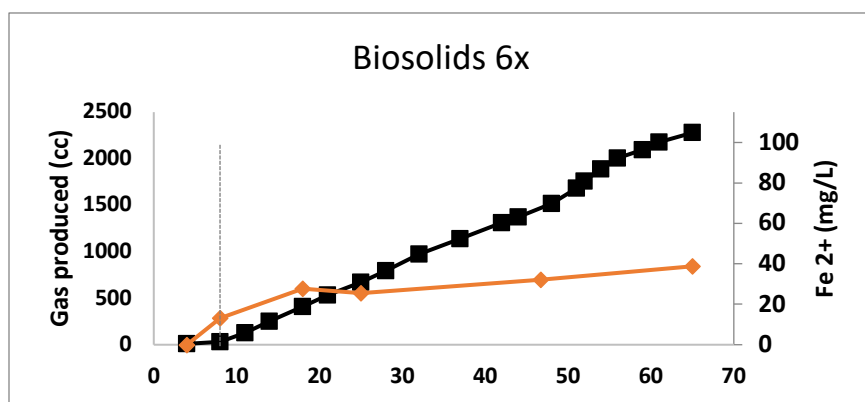
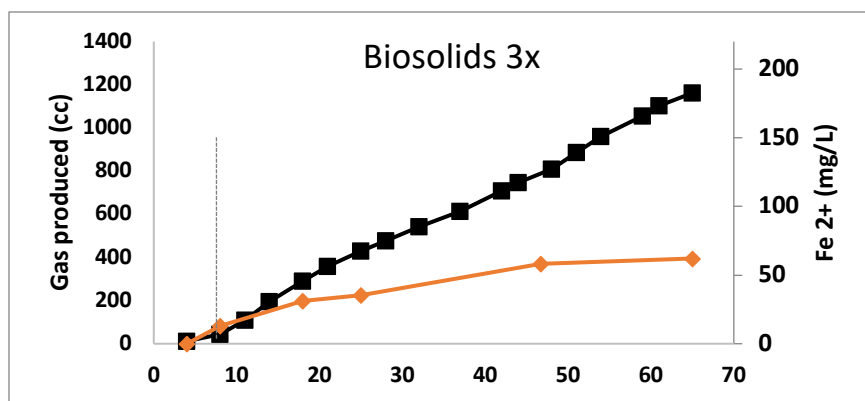
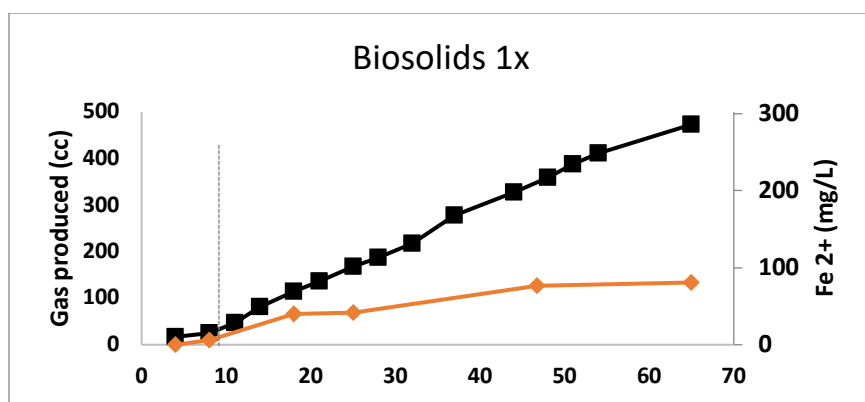
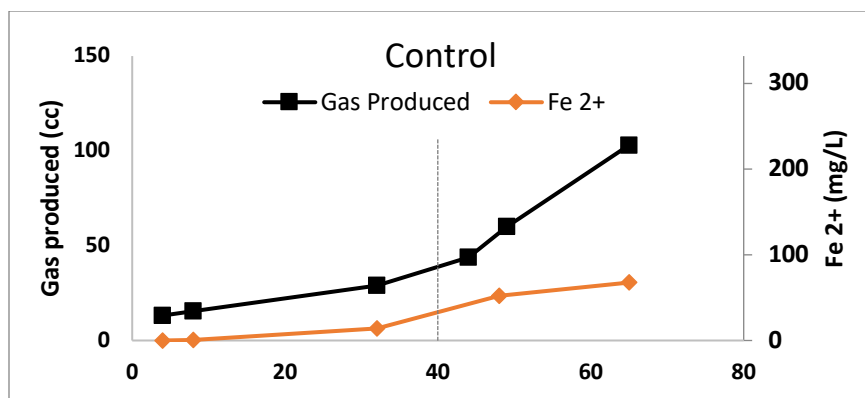
Supplemental Figure S4a. Experiment 1. Biogenic methane gas production rate in the SL soil versus the SCL mesocosms. The SL mesocosms had, on average, 2.4 times higher gas production than the SCL.



Supplemental Figure S4b. Experiment 1. Total biogenic gas production rate in the SL soil versus the SCL mesocosms. The SL mesocosms had, on average, 2.6 times higher gas production than the SCL.



Supplemental Figure S5. Typical gas saturated soils amended with organic matter (All Experiments). Gases were best modeled using a segmented linear function. After a breakpoint the average total gas production increases by a factor of 5 whereas there is a sharp increase in methane production. Note that hay amended trials exhibited a typical sinusoidal pattern.



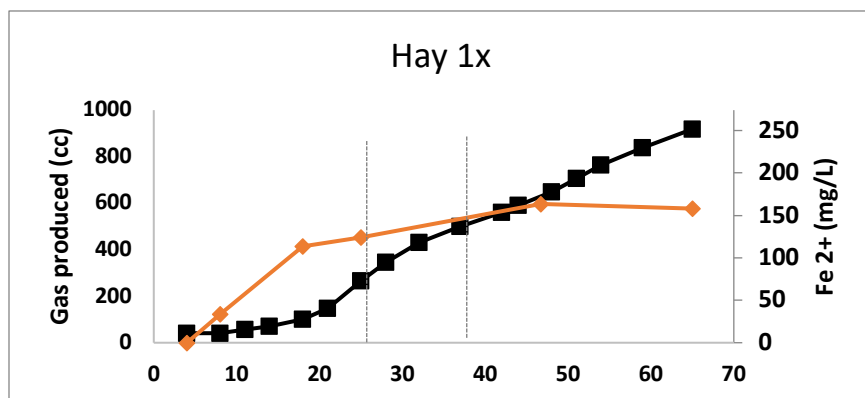
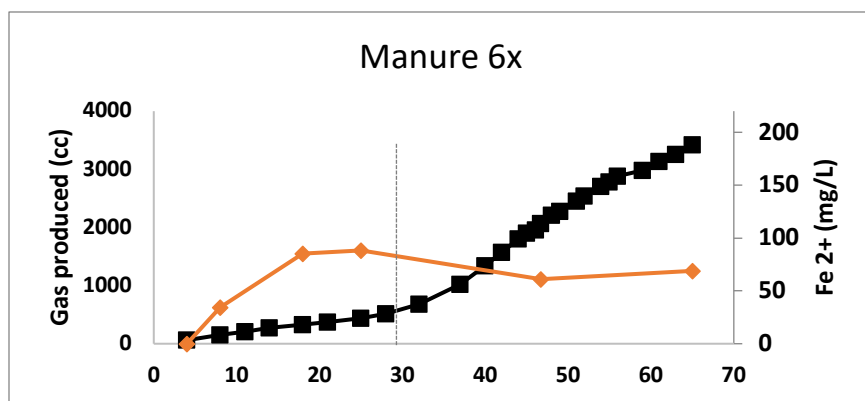
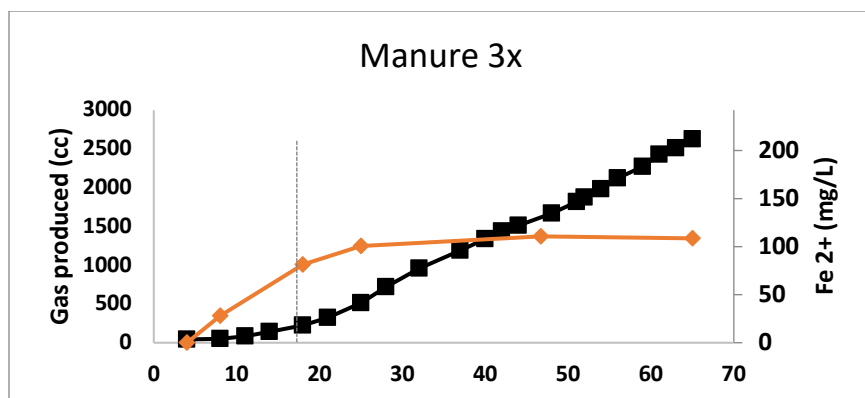
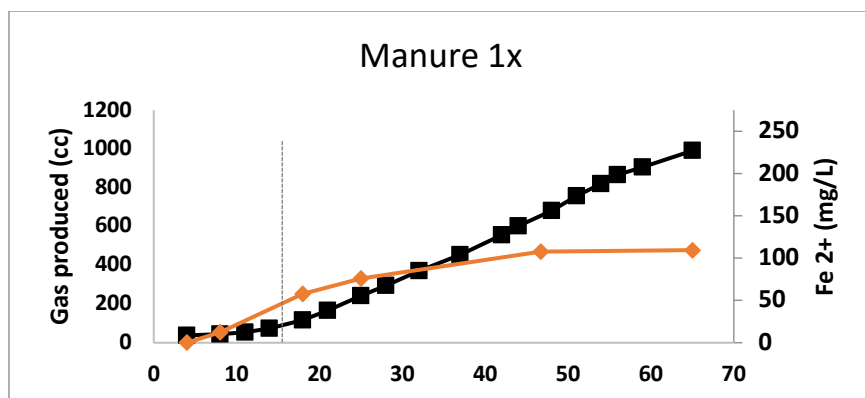
Supplemental Figure S6.
Experiment 1.
Biogenic gas
and ferrous iron
versus time.

x-axis – incubation time
(days)

Soil – Sandy Loam

The maximum y axis
value represents the
theoretical maximum
based on hydroxyl amine
hydrochloride extractable
iron oxides in the soil.

The vertical dashed line
represents Ts.



Supplemental Figure S6 (cont.).

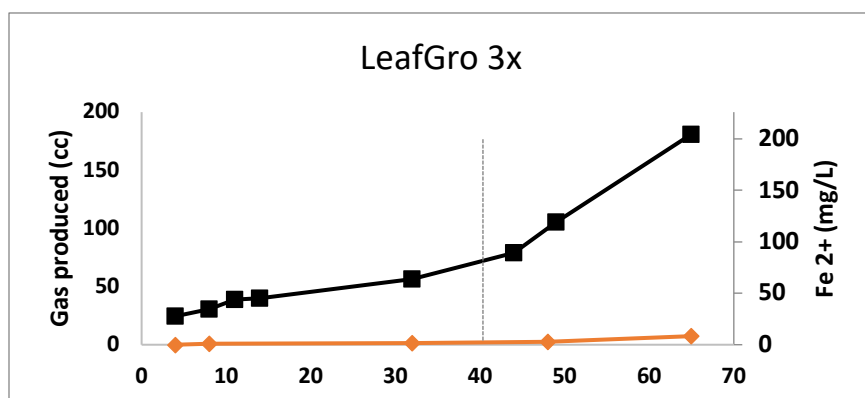
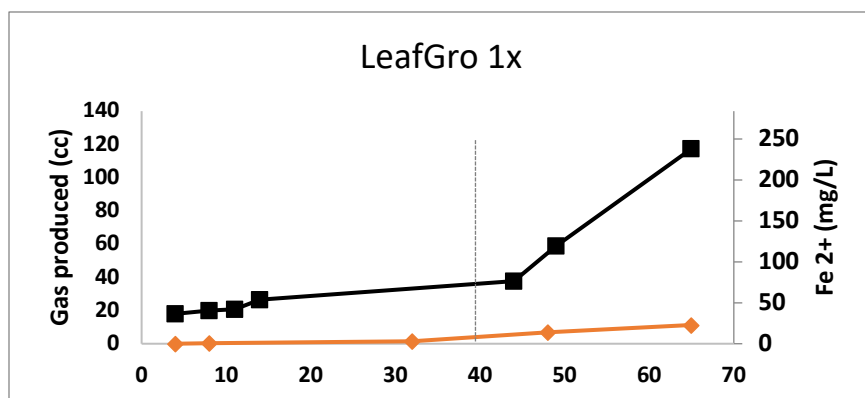
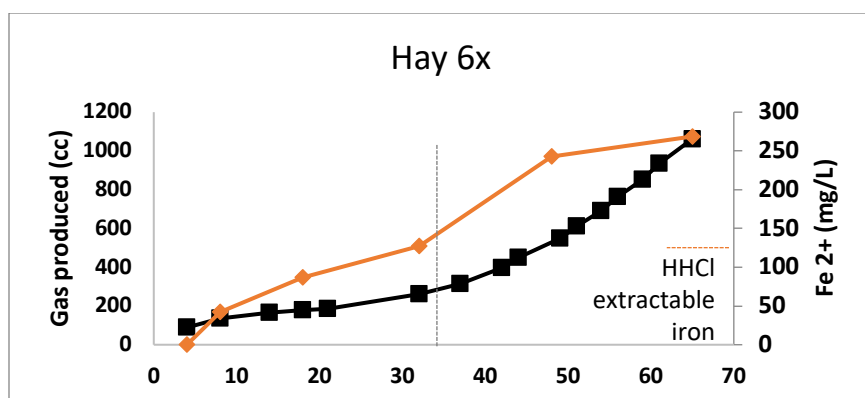
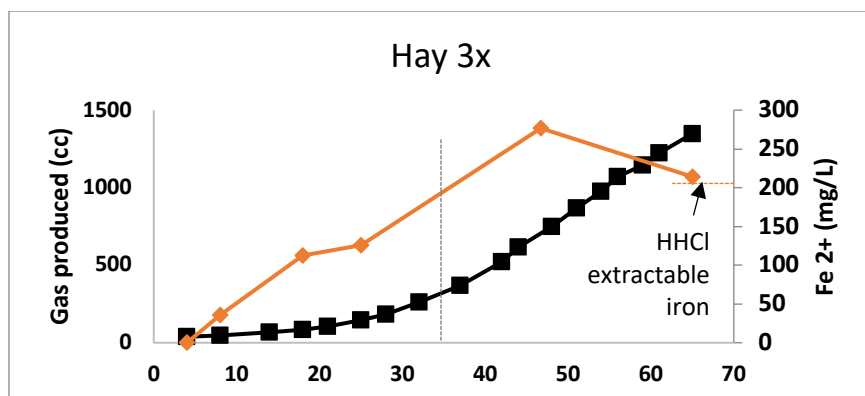
Biogenic gas and ferrous iron versus time.

x-axis – incubation time (days)

Soil – Sandy Loam

The maximum y axis value represents the theoretical maximum based on hydroxyl amine hydrochloride extractable iron oxides in the soil.

The vertical dashed line represents Ts.



Supplemental Figure S6
(cont.).

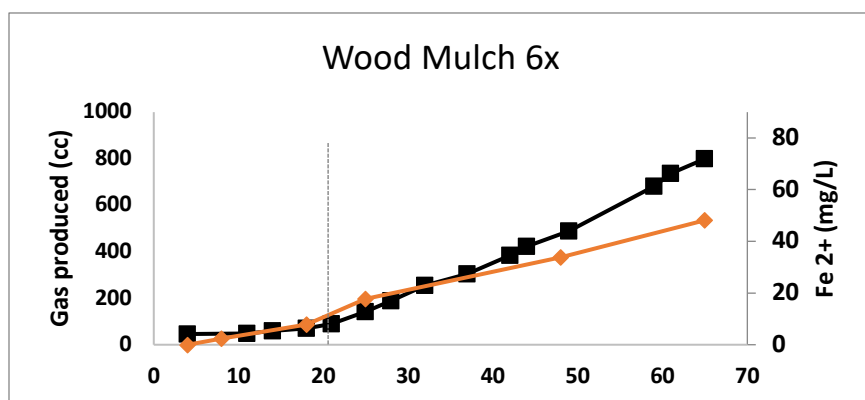
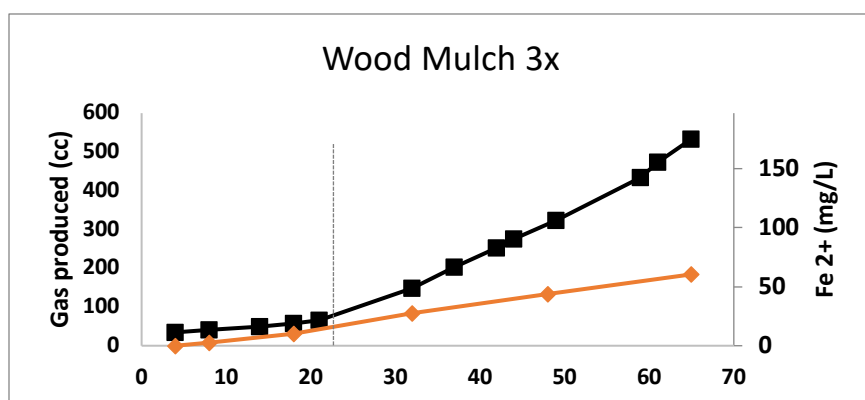
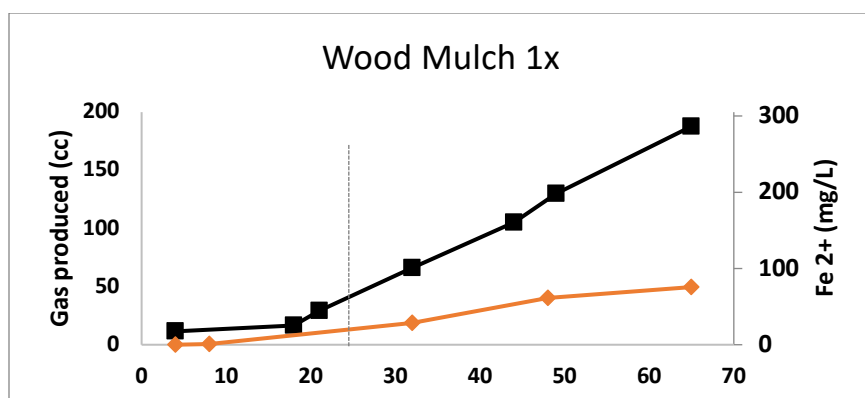
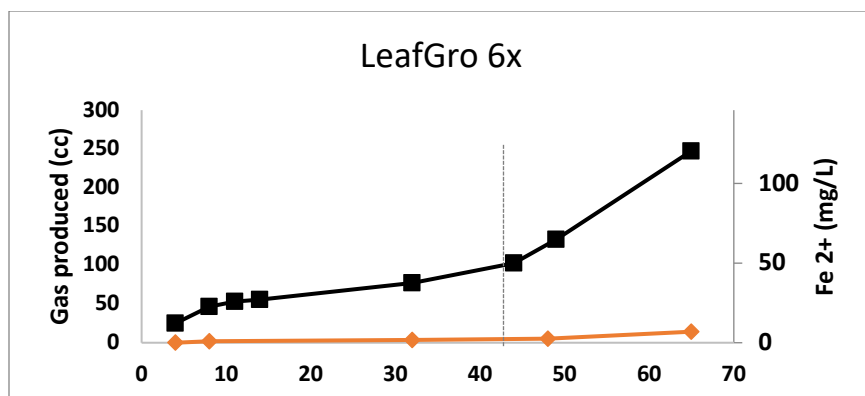
Biogenic gas
and ferrous iron
versus time.

x-axis – incubation time
(days)

Soil – Sandy Loam

The maximum y axis
value represents the
theoretical maximum
based on hydroxyl amine
hydrochloride (HHCl)
extractable iron oxides in
the soil.

The vertical dashed line
represents Ts.



Supplemental Figure S6
(cont.).

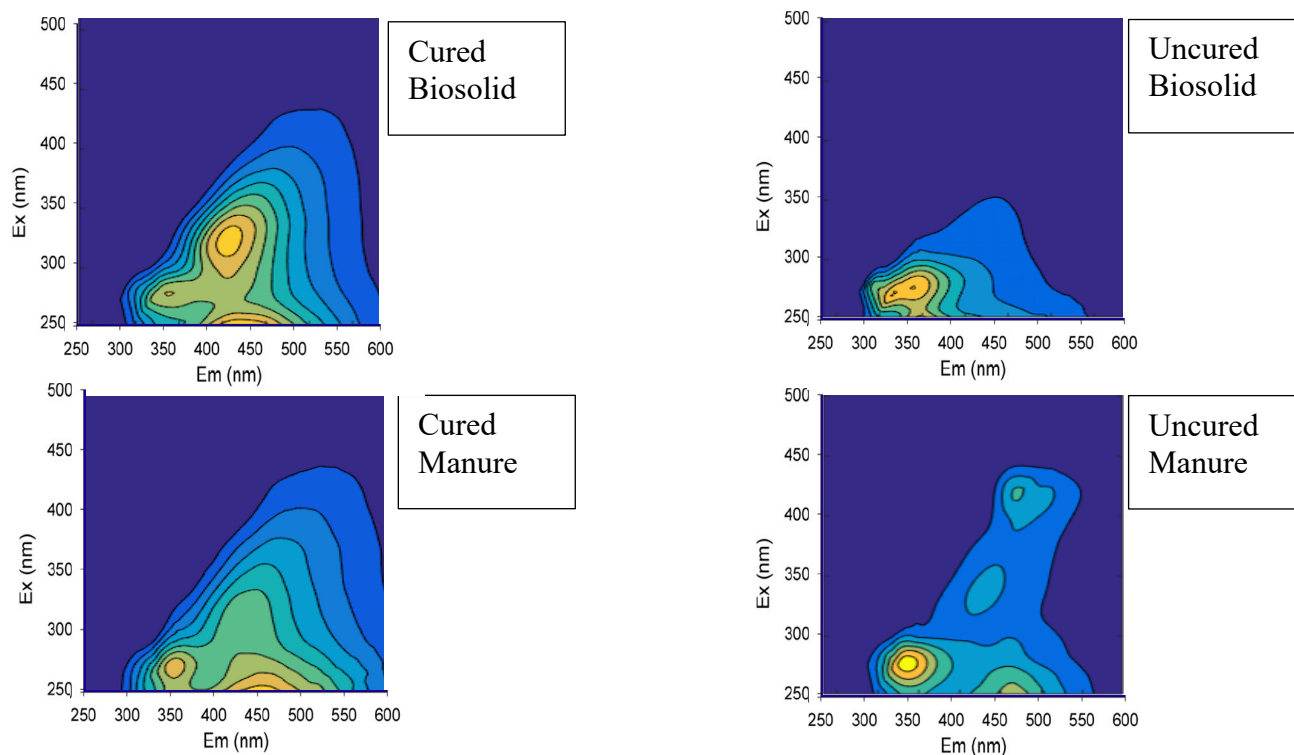
Biogenic gas
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Supplemental Figure S7. Experiment 2. Fluorescent spectral scans of amendments of organic amendments. Scans used dissolved organic carbon from water extractions. The vertical axis is emission wavelength and the horizontal axis is the excitation wavelength. Colors represent emission intensity (blue = low, yellow = high). Dissolved organic carbon that is red-shifted, or stretched upward, is considered to have higher levels of organic acids and a lower nominal oxygen state and lower chemical energy.

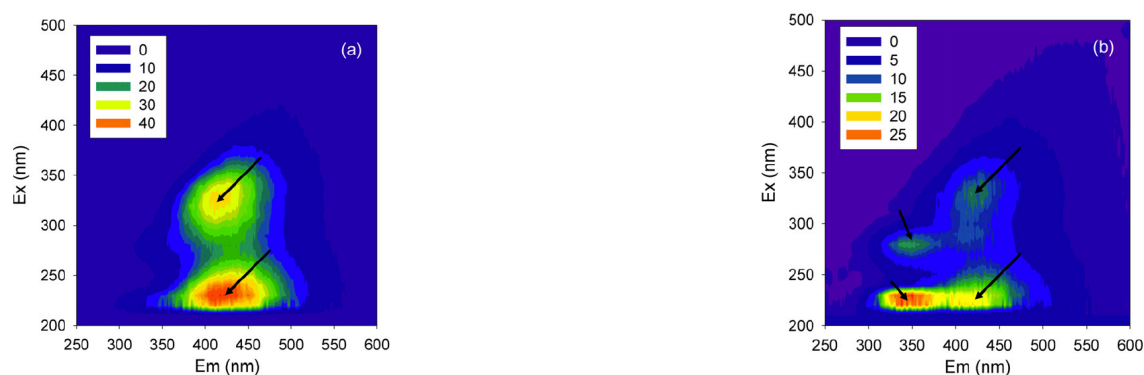
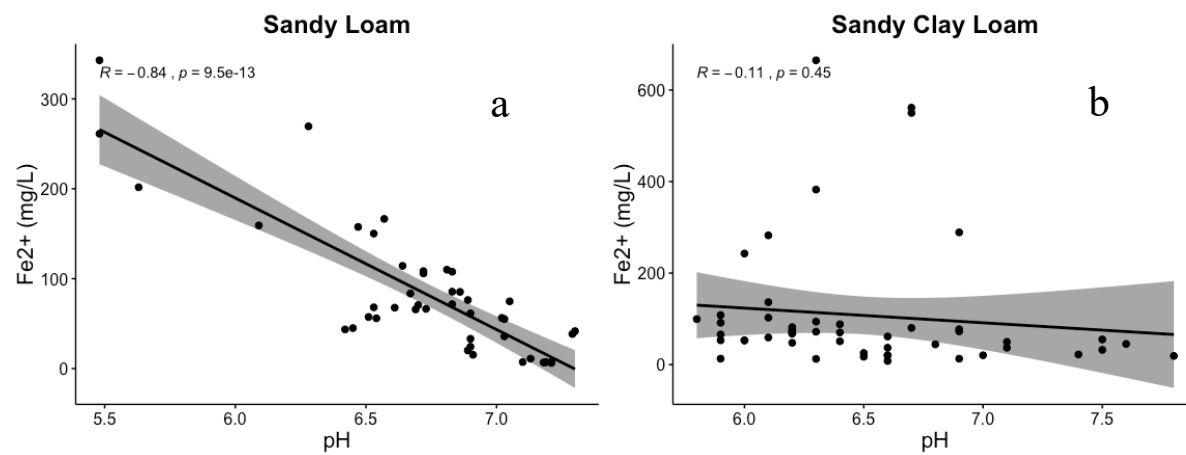
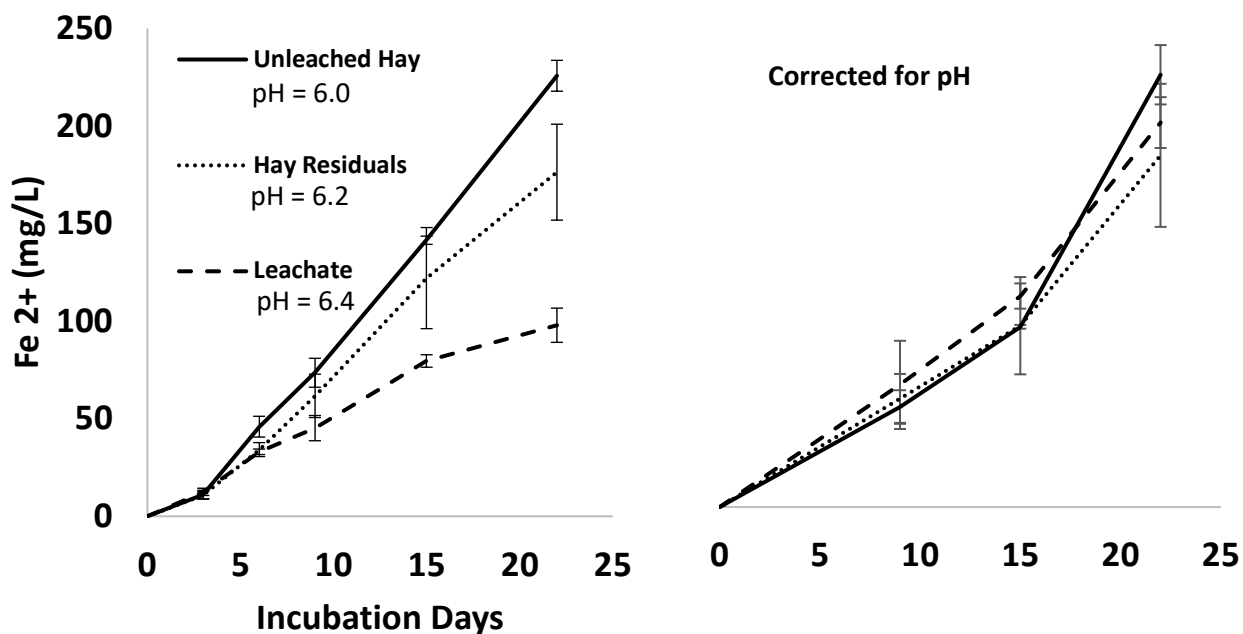


Figure 2 from Yu et al. 2010. Typical EEM contours of mature (a) and immature (b) composts.

Yu, G.-H., Luo, Y.-H., Wu, M.-J., Tang, Z., Liu, D.-Y., Yang, X.-M. and Shen, Q.-R.: PARAFAC modeling of fluorescence excitation–emission spectra for rapid assessment of compost maturity, *Bioresource Technology*, 101(21), 8244–8251, doi:10.1016/j.biortech.2010.06.007, 2010.



Supplemental Figure S8. Experiment 1. Ferrous iron (Fe^{2+}) concentration versus pH. Values taken after 60 days of incubation of saturated soils with various organic matter amendments.



Supplemental Figure S9. Experiment 4. Ferrous iron concentrations with hay leachate and residuals mathematically corrected for the pH relationship observed in Supplemental Figure S8a.

Observed pH and Fe^{2+} values for day 22 of the incubation are summarized in the table below:

A linear regression of these values yields:

$$\text{Fe} = \text{pH} * (-115.7) + 815.5 \quad r^2 = 0.73, p = 0.003$$

We corrected Fe values using a reference value of pH value, which was /an intermediate pH in preceding experiments.

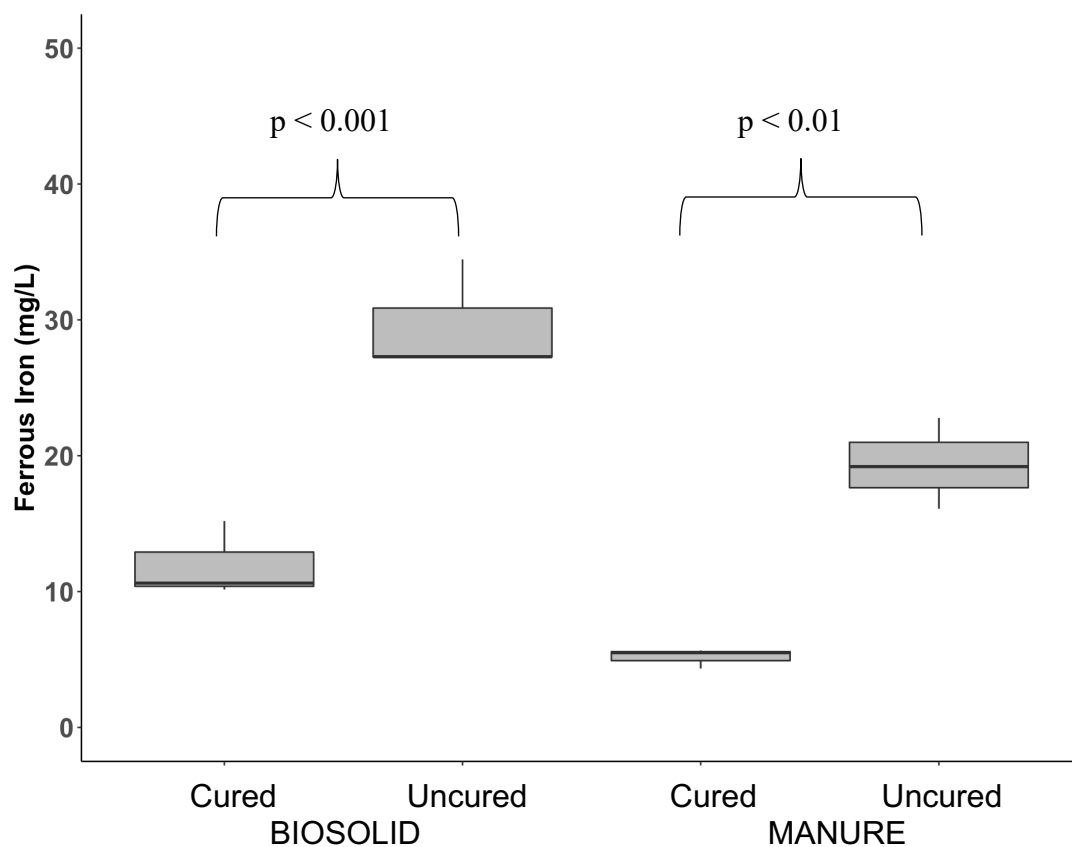
$$\text{Fe}_{(\text{corrected})} = \text{Fe}_{(\text{observed})} * ((6.2 - \text{pH}) * (-115.7))$$

ANOVA analysis shows the $\text{Fe}_{(\text{observed})}$ were different ($p < 0.05$), but

$\text{Fe}_{(\text{corrected})}$ were not ($p = 0.61$).

The pH correction would only be valid around the average Fe value of ~100 mg/L, so the correction factor was scaled based on the average Fe value at the time interval, or $-115.7 * \text{Fe}_{(\text{observed_average})}/100$.

pH	Fe _(observed)	Fe _(corrected)
6.08	132.8	120.34
5.96	121.6	95.26
5.96	112.8	86.46
6.16	100.8	97.59
6.18	102.4	101.50
6.24	108.8	114.84
6.38	73.6	95.83
6.38	79.2	101.43
6.35	67.2	85.96



Supplemental Figure S10. Experiment 2. Ferrous iron concentration in the liquid phase at the end of the incubation period (13 days). Incubation was carried out with SL soil. The aged organic materials were from the same source but had been aged for at least 3 months. Figure S10 represents the same data shown in Figure 2, but were were mathematically corrected for the pH relationship as described in Supplemental Figure S9.