Table 1: List of species and substrate combinations used for each experimental unit.

Species	**Substrate**
Pleurotus ostreatus	Straw + Cotton
Pleurotus ostreatus	Mesquite + Alfalfa
Pleurotus ostreatus	Oak + Soy
Ganoderma lucidum	Straw + Cotton
Ganoderma lucidum	Mesquite + Alfalfa
Ganoderma lucidum	Oak + Soy
Trametes versicolor	Straw + Cotton
Trametes versicolor	Mesquite + Alfalfa
Trametes versicolor	Oak + Soy
N/A	N/A

Table 2: Constants used to convert carbon dioxide PPM gained per given volume into moles

Liter / quart	=	1.058
Grams / Liter	=	44
1 ppm	=	0.0001%
Gram / mole of C02	=	44.01

Table 3: Constants used for ideal gas law equation $PV = nRT$

Pressure (Tucson)	93045.2	Pa
Volume	0.113562	m^3
n	**4.248189**	**mol**
R	8.314463	m^3·Pa·K^−1·mol^−1
T	299.15	K

Table 4: Carbon dioxide generation from first trial. SC denotes straw/cotton, MA denotes mesquite/alfalfa, and OS denotes oak/soy. The numbers following the substrate denotes the replicates within the trial.

Trial	Species	Substrate	Response	Units
1	*Pleurotus ostreatus*	SC 1	2.18	Grams of C02 / Day / Bag
1	*Pleurotus ostreatus*	SC 2	2.38	Grams of C02 / Day / Bag
1	*Pleurotus ostreatus*	SC 3	2.61	Grams of C02 / Day / Bag
1	*Pleurotus ostreatus*	MA 1	4.84	Grams of C02 / Day / Bag
1	*Pleurotus ostreatus*	MA 2	4.34	Grams of C02 / Day / Bag
1	*Pleurotus ostreatus*	MA 3	4.24	Grams of C02 / Day / Bag
1	*Pleurotus ostreatus*	OS 1	3.90	Grams of C02 / Day / Bag
1	*Pleurotus ostreatus*	OS 2	2.66	Grams of C02 / Day / Bag
1	*Pleurotus ostreatus*	OS 3	3.28	Grams of C02 / Day / Bag
2	*Ganoderma lucidum*	SC 1	1.93	Grams of C02 / Day / Bag
2	*Ganoderma lucidum*	SC 2	3.23	Grams of C02 / Day / Bag
2	*Ganoderma lucidum*	SC 3	1.93	Grams of C02 / Day / Bag
2	*Ganoderma lucidum*	MA 1	5.82	Grams of C02 / Day / Bag
2	*Ganoderma lucidum*	MA 2	4.03	Grams of C02 / Day / Bag
2	*Ganoderma lucidum*	MA 3	5.01	Grams of C02 / Day / Bag
2	*Ganoderma lucidum*	OS 1	4.84	Grams of C02 / Day / Bag
2	*Ganoderma lucidum*	OS 2	5.00	Grams of C02 / Day / Bag
2	*Ganoderma lucidum*	OS 3	4.21	Grams of C02 / Day / Bag
3	*Trametes versicolor*	SC 1	3.97	Grams of C02 / Day / Bag
3	*Trametes versicolor*	SC 2	4.09	Grams of C02 / Day / Bag
3	*Trametes versicolor*	SC 3	5.21	Grams of C02 / Day / Bag
3	*Trametes versicolor*	MA 1	6.61	Grams of C02 / Day / Bag
3	*Trametes versicolor*	MA 2	4.89	Grams of C02 / Day / Bag
3	*Trametes versicolor*	MA 3	6.28	Grams of C02 / Day / Bag
3	*Trametes versicolor*	OS 1	4.71	Grams of C02 / Day / Bag
3	*Trametes versicolor*	OS 2	4.90	Grams of C02 / Day / Bag
3	*Trametes versicolor*	OS 3	3.38	Grams of C02 / Day / Bag

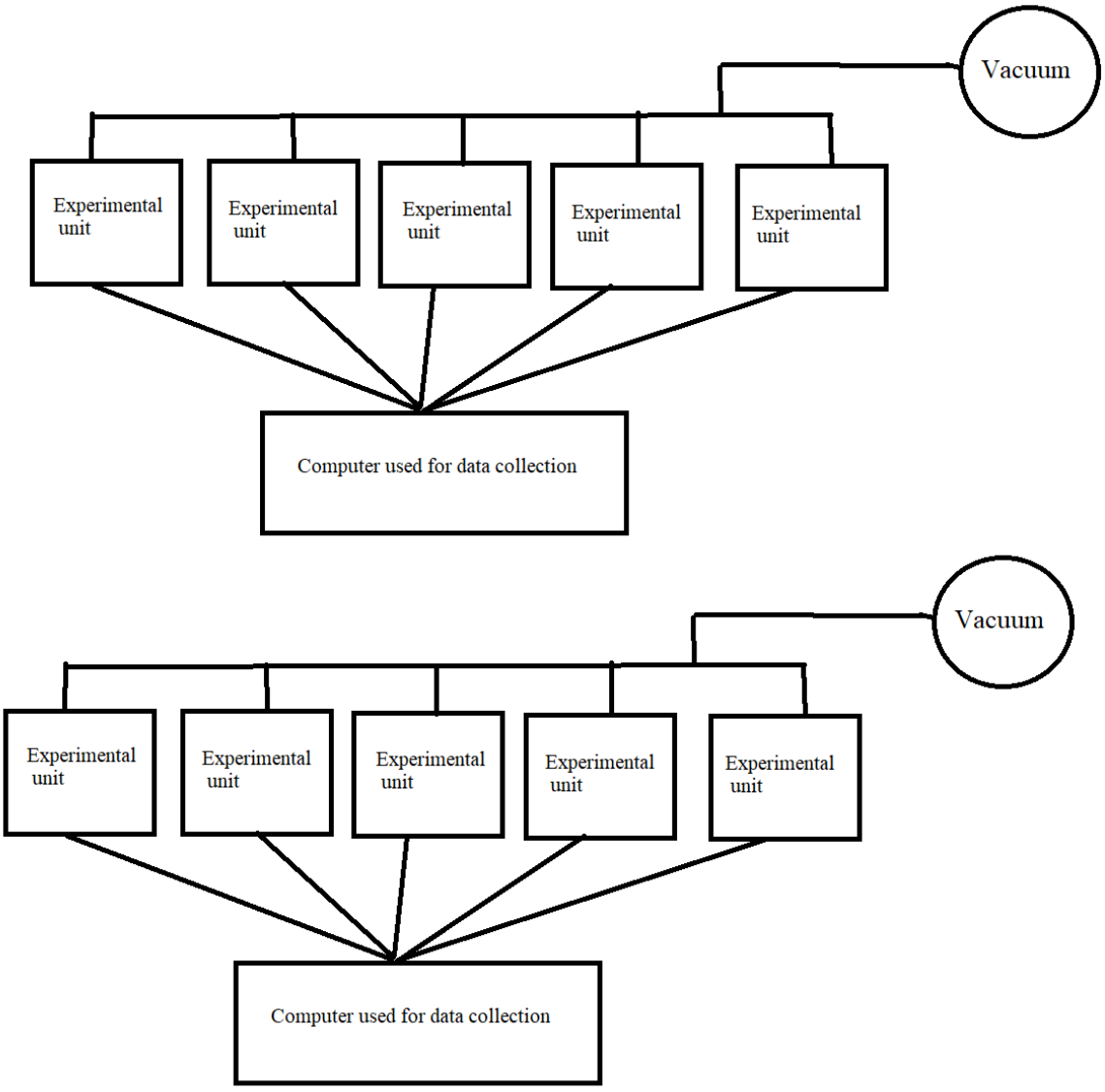

Figure 1: Schematic of experiment showing two sets of five experimental units connected to a data collection source and a venting source.

Figure 2: Photos showing the experimental units at the vertical farm facility at the University of Arizona's Controlled Environment Agriculture Center. Figure 3a shows the venting system and the data collection software Gaslab^{TM}. Figure 3b shows the manifold system for exhausting CO_2.

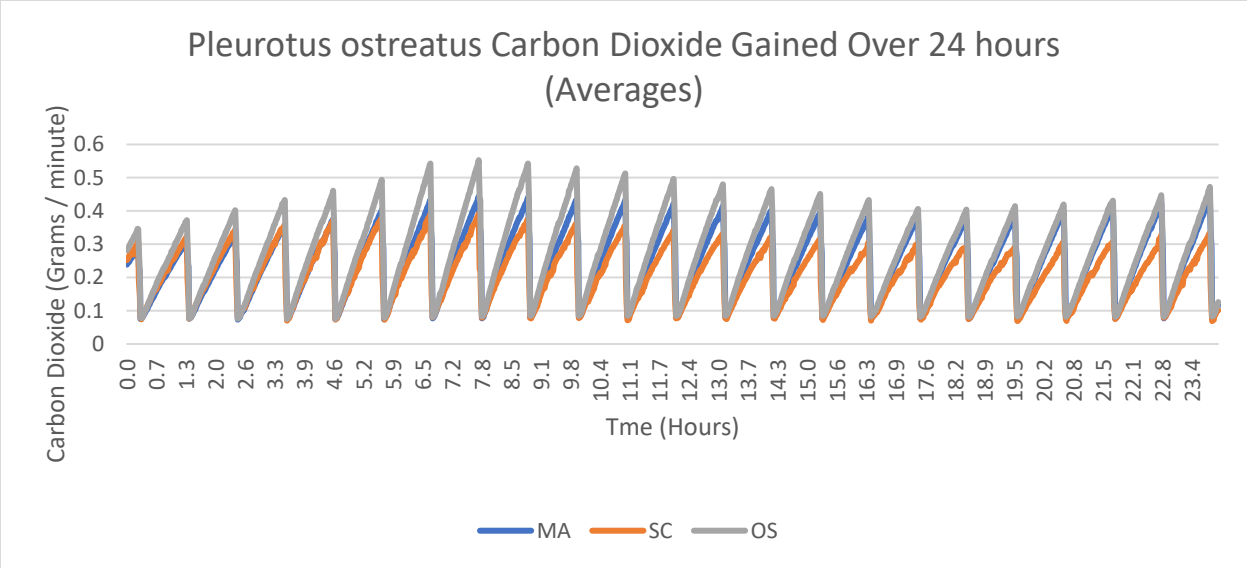

Figure 3: *Pleurotus ostreatus* carbon dioxide generation (grams/minute) over 24 hours for three different substrates: MA – mesquite/alfalfa; OS - oak/soy; SC – straw/cotton.

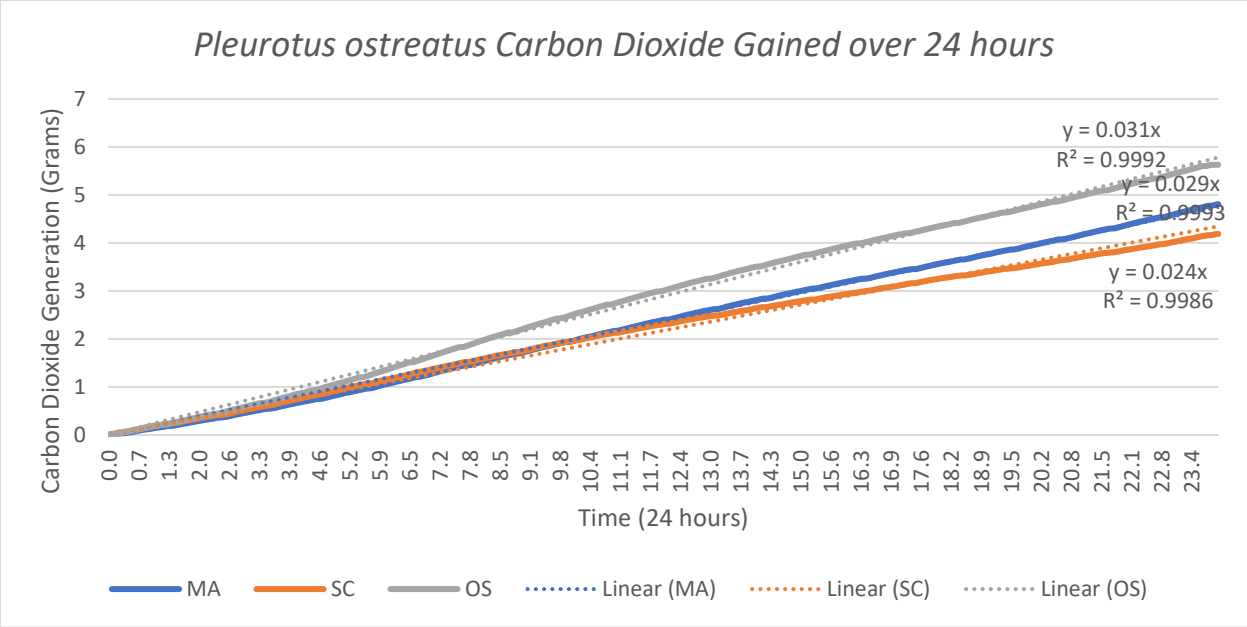

Figure 4: Carbon dioxide generation (grams) of *Pleurotus ostreatus* gained over a course of 24 hours for three different substrates: MA – mesquite/alfalfa; OS - oak/soy; SC – straw/cotton.

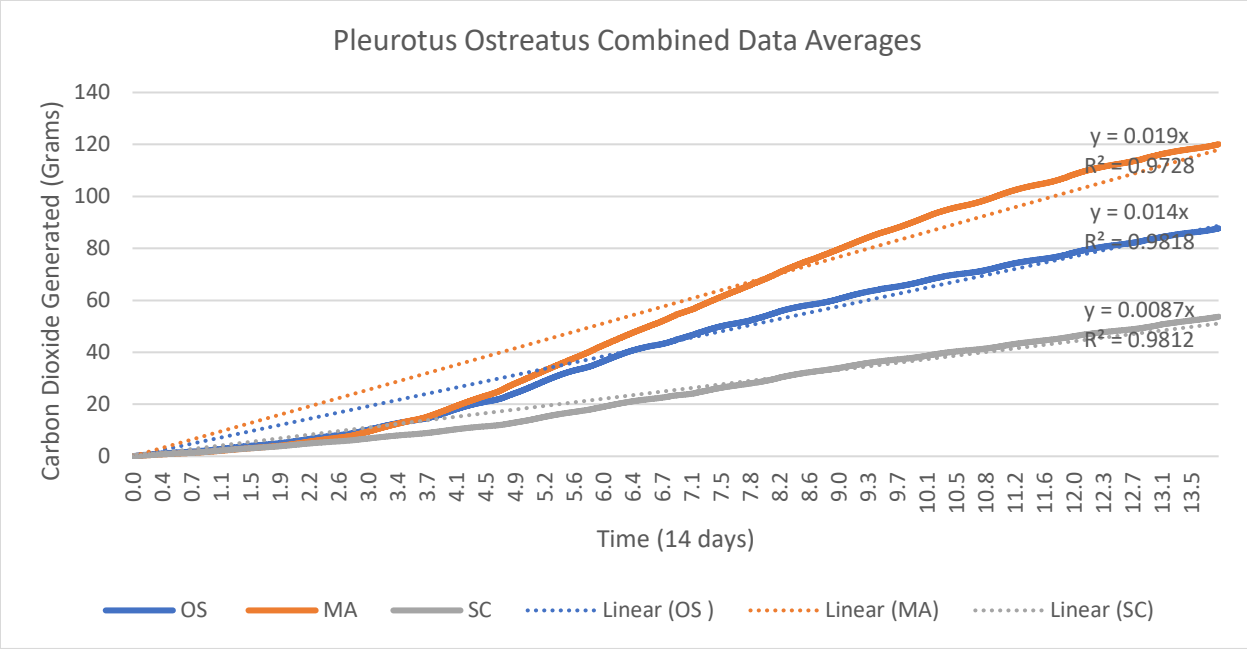

Figure 5: *Pleurotus ostreatus* combined CO_2 averages over 14 days for three different substrates: MA – mesquite/alfalfa; OS - oak/soy; SC – straw/cotton. (note color change in substrate legend compared to Figs 3 and 4)

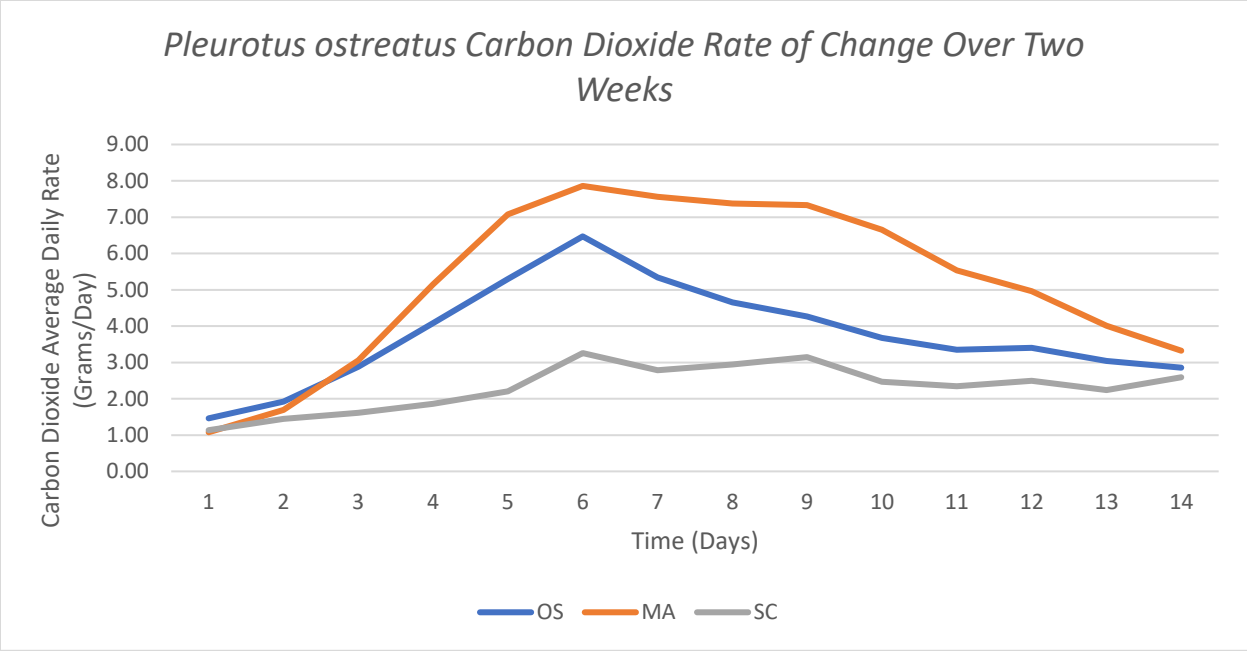

Figure 6: *Pleurotus ostreatus* rate of change over 14 days for three different substrates: MA – mesquite/alfalfa; OS - oak/soy; SC – straw/cotton. Highest rate of change between days 4 and 8.

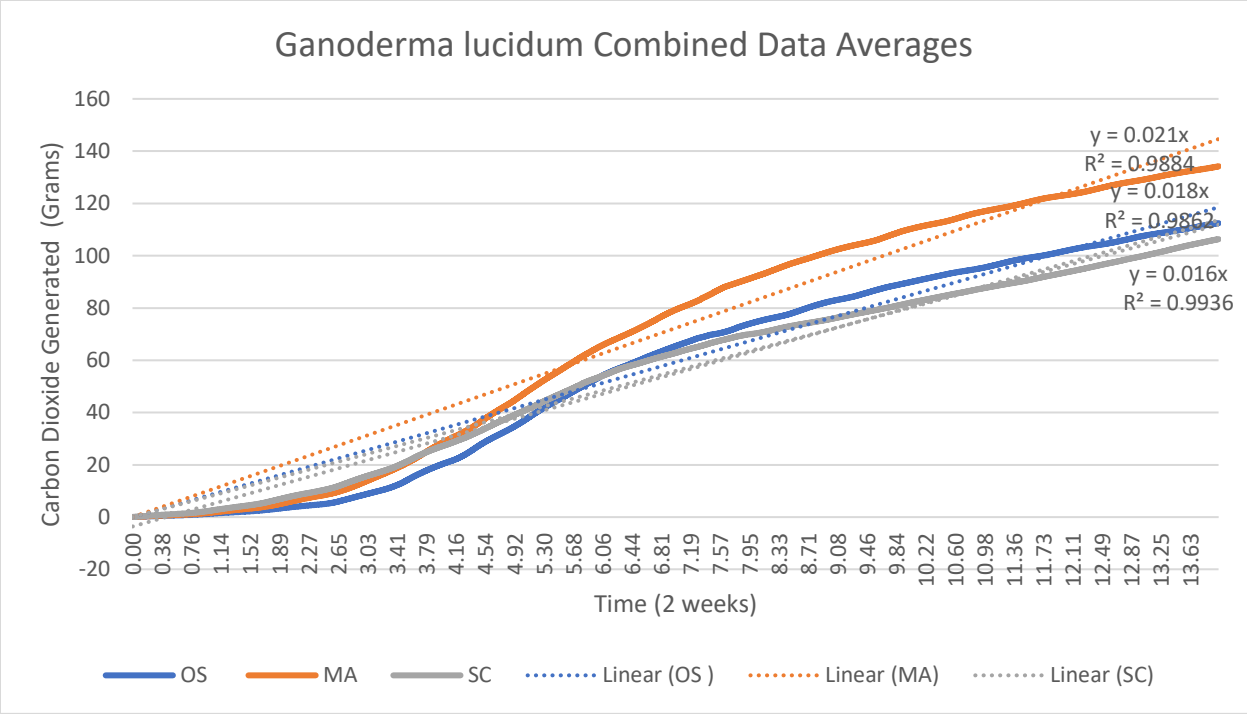

Figure 7: *Ganoderma lucidum* combined data averages over 14 days for three different substrates: MA – mesquite/alfalfa; OS - oak/soy; SC – straw/cotton

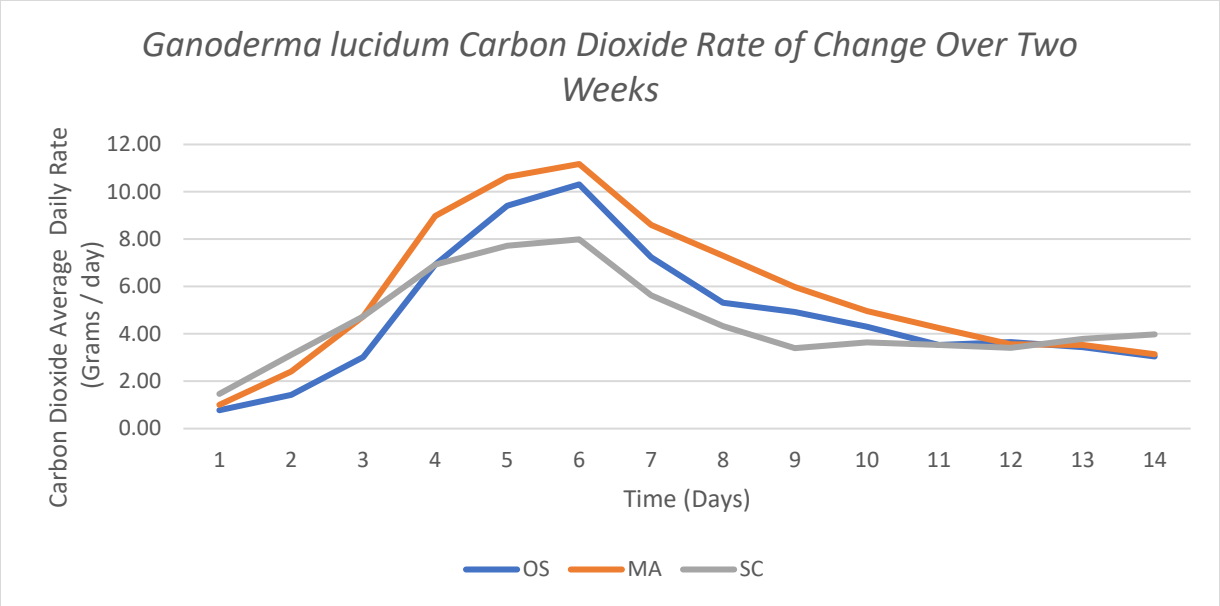

Figure 8: *Ganoderma lucidum* rate of change over 14 days for three different substrates: MA – mesquite/alfalfa; OS - oak/soy; SC – straw/cotton. Highest rate of change between days 2 and 6.

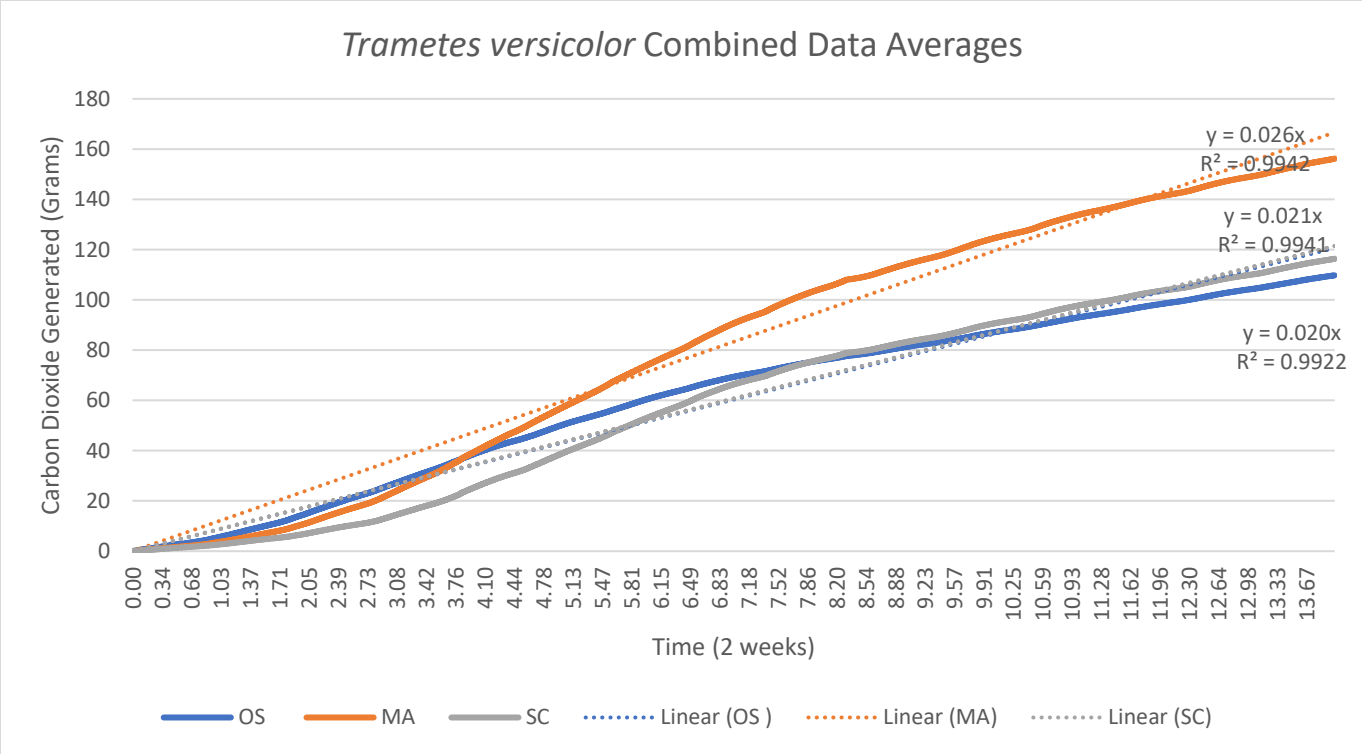

Figure 9: *Trametes versicolor* combined data averages over 14 days for three different substrates:

MA – mesquite/alfalfa; OS - oak/soy; SC – straw/cotton.

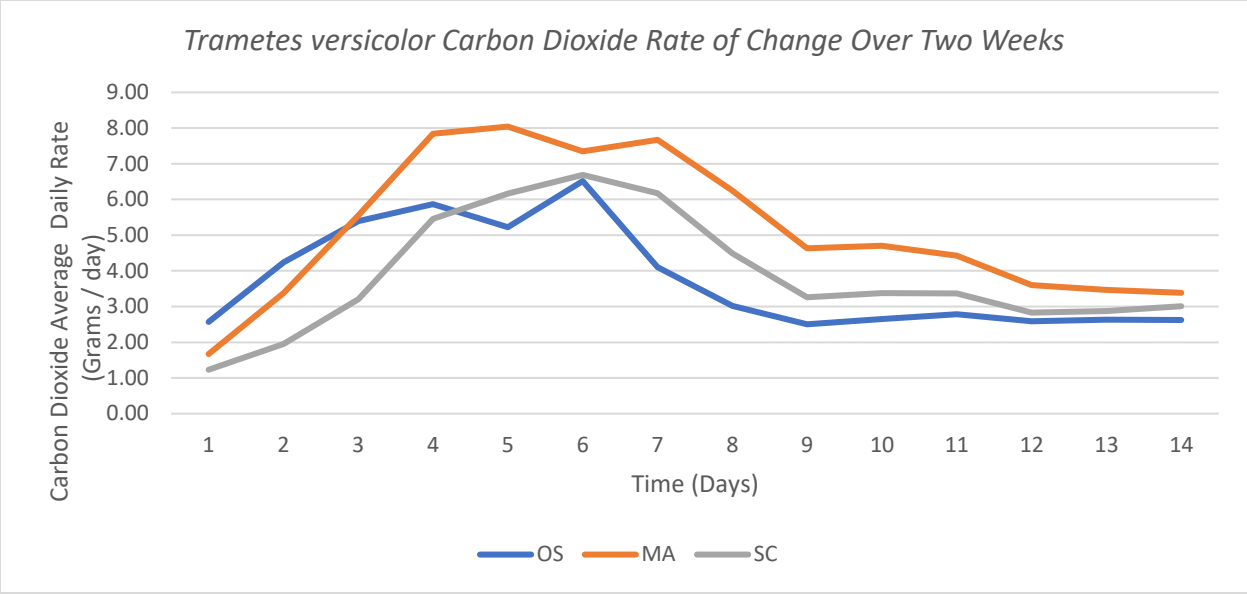

Figure 10: *Trametes versicolor* rate of change over 14 days for three different substrates: MA – mesquite/alfalfa; OS - oak/soy; SC – straw/cotton. Highest rate of change between days 2 and 6.

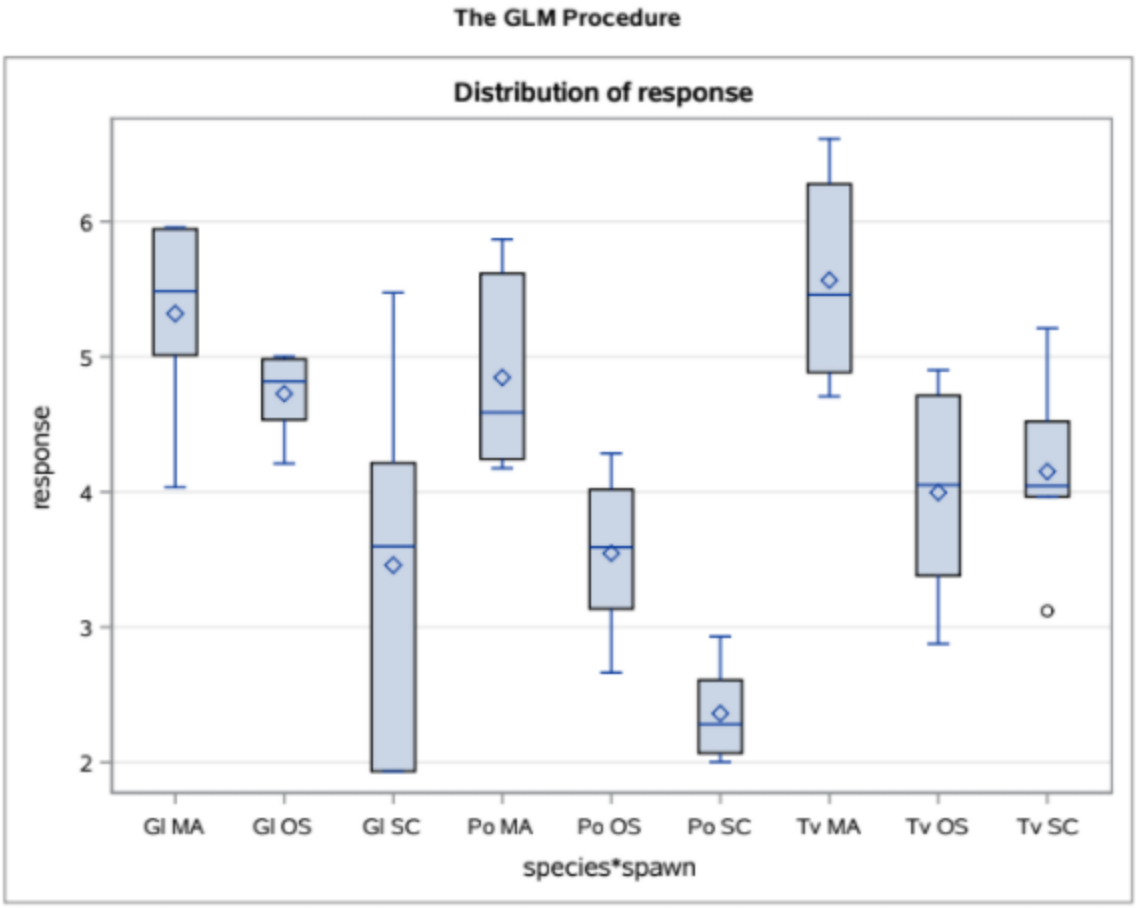

Figure 11: Distribution of carbon dioxide responses for interaction between species (*Ganoderma lucidum, Pleurotus ostreatus, Trametes versicolor)* and substrate (MA – mesquite/alfalfa; OS - oak/soy; SC – straw/cotton). The units for the responses are grams of carbon dioxide generated per day per bag.

Dependent Variable: response response

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	49.28285311	6.16035664	10.19	<.0001
Error	45	27.19721007	0.60438245		
Corrected Total	53	76.48006318			

R-Square	Coeff Var	Root MSE	response Mean
0.644388	18.42567	0.777420	4.219225

Source	DF	Type I SS	Mean Square	F Value	Pr > F
species	2	10.90391146	5.45195573	9.02	0.0005
spawn	2	33.65287472	16.82643736	27.84	<.0001
species*spawn	4	4.72606693	1.18151673	1.95	0.1178

Source	DF	Type III SS	Mean Square	F Value	Pr > F
species	2	10.90391146	5.45195573	9.02	0.0005
spawn	2	33.65287472	16.82643736	27.84	<.0001
species*spawn	4	4.72606693	1.18151673	1.95	0.1178

Figure 12: Type III Sum of Squares Analysis for species, substrate, and interaction between species and substrate. Species and spawn are significant factors with a p-value of 0.005 and <.0001 respectively.

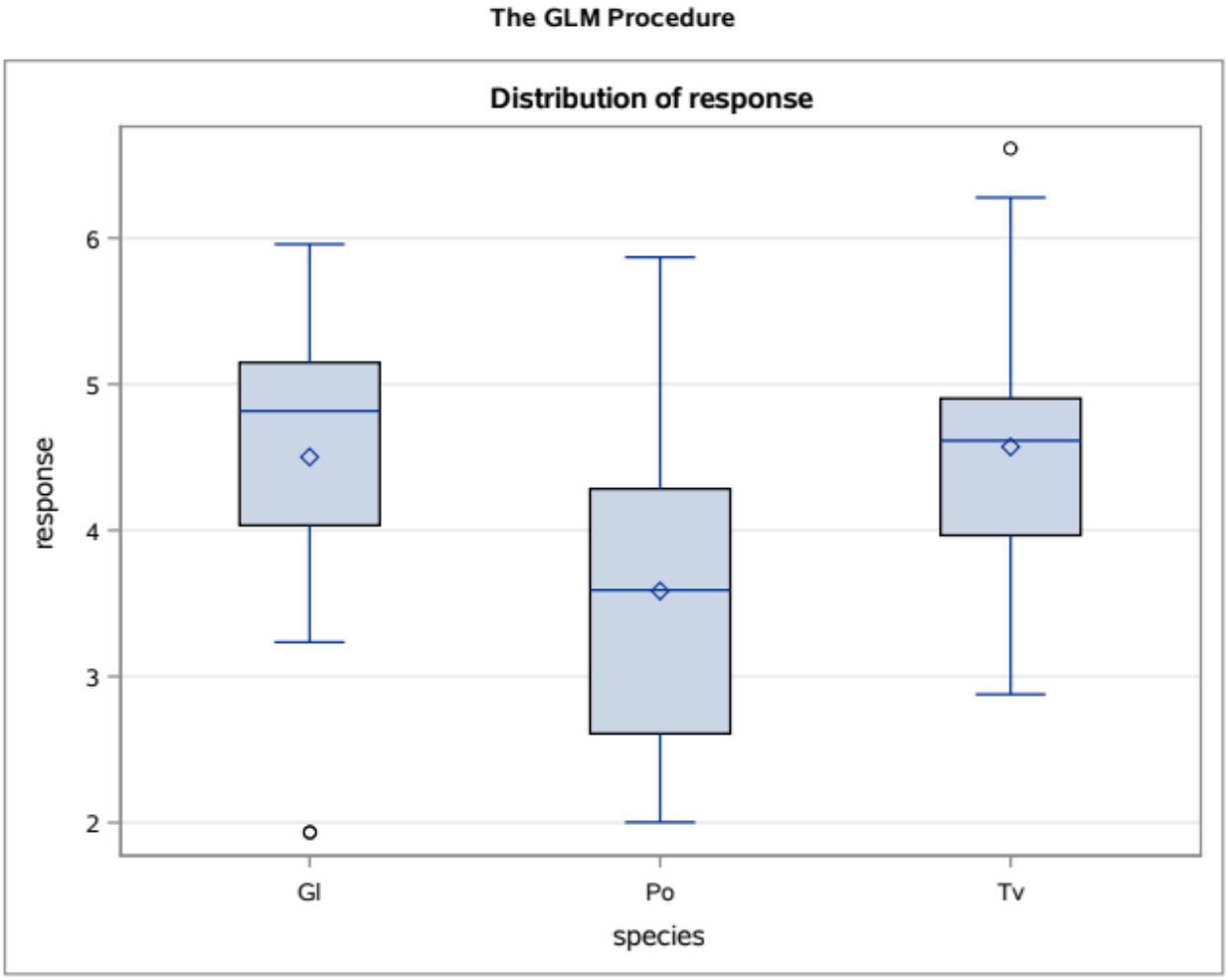

Figure 13: Distribution of carbon dioxide response for species (*Ganoderma lucidum, Pleurotus ostreatus, Trametes versicolor)* only. *Trametes versicolor* shows the highest response range. The units for the responses are grams of carbon dioxide generated per day per bag.

Tukey's Studentized Range (HSD) Test for resp

Note: This test controls the Type I experimentwise error rate, but it generally has a higher Type II error rate than REGWQ.

Alpha	0.05
Error Degrees of Freedom	18
Error Mean Square	0.451344
Critical Value of Studentized Range	3.60930
Minimum Significant Difference	0.8083

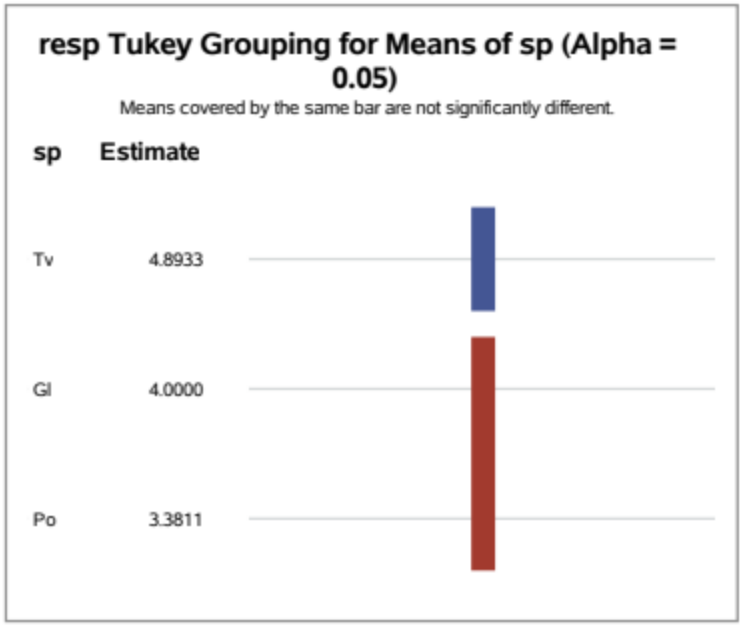

Figure 14: Tukey test for three different species – *Trametes versicolor, Ganoderma lucidum, Pleurotus ostreatus*. *Trametes versicolor* produces statistically more carbon dioxide than both *Pleurotus ostreatus* and *Ganoderma lucidum*.

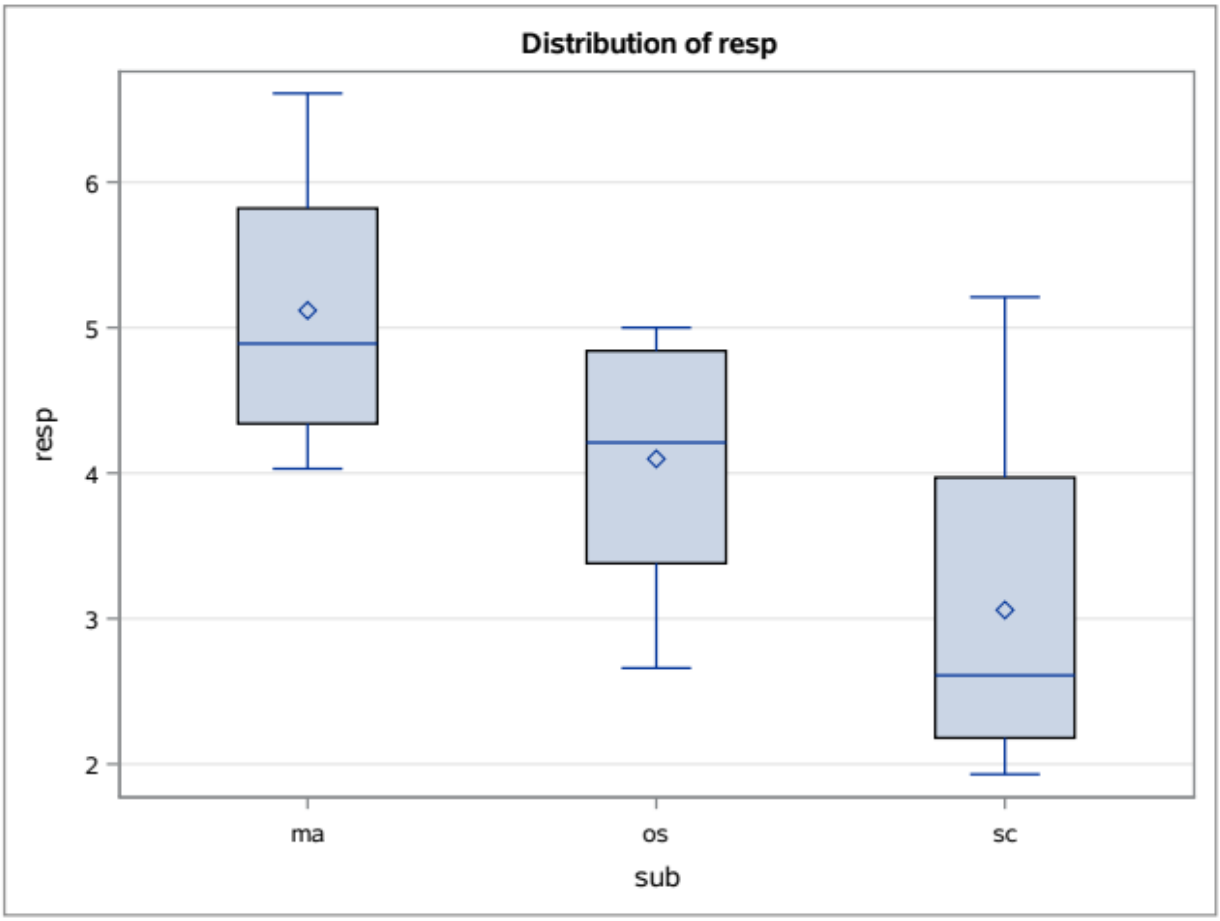

Figure 15: Distribution of responses for three substrates: MA – mesquite/alfalfa; OS - oak/soy; SC – straw/cotton. The units for the responses are grams of carbon dioxide generated per day per bag.

The GLM Procedure

Tukey's Studentized Range (HSD) Test for resp

Note: This test controls the Type I experimentwise error rate, but it generally has a higher Type II error rate than REGWQ.

Alpha	0.05
Error Degrees of Freedom	18
Error Mean Square	0.451344
Critical Value of Studentized Range	3.60930
Minimum Significant Difference	0.8083

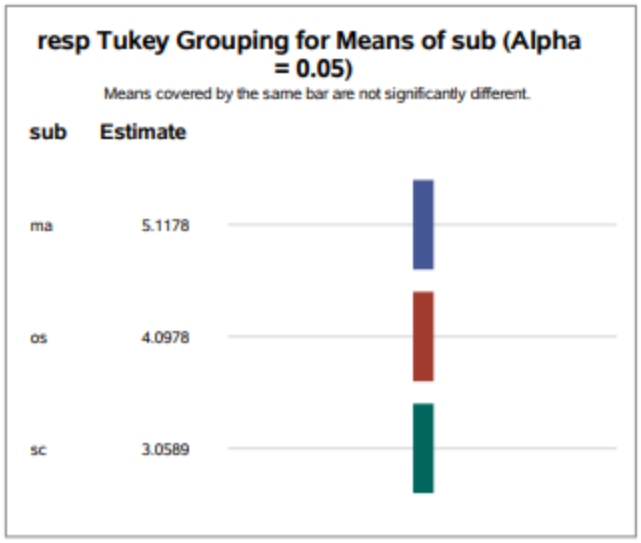

Figure 16: Tukey test for three different substrates: MA – mesquite/alfalfa; OS - oak/soy; SC – straw/cotton. Mesquite/alfalfa produces the most amount of carbon dioxide, followed by oak/soy, followed by straw/cotton.

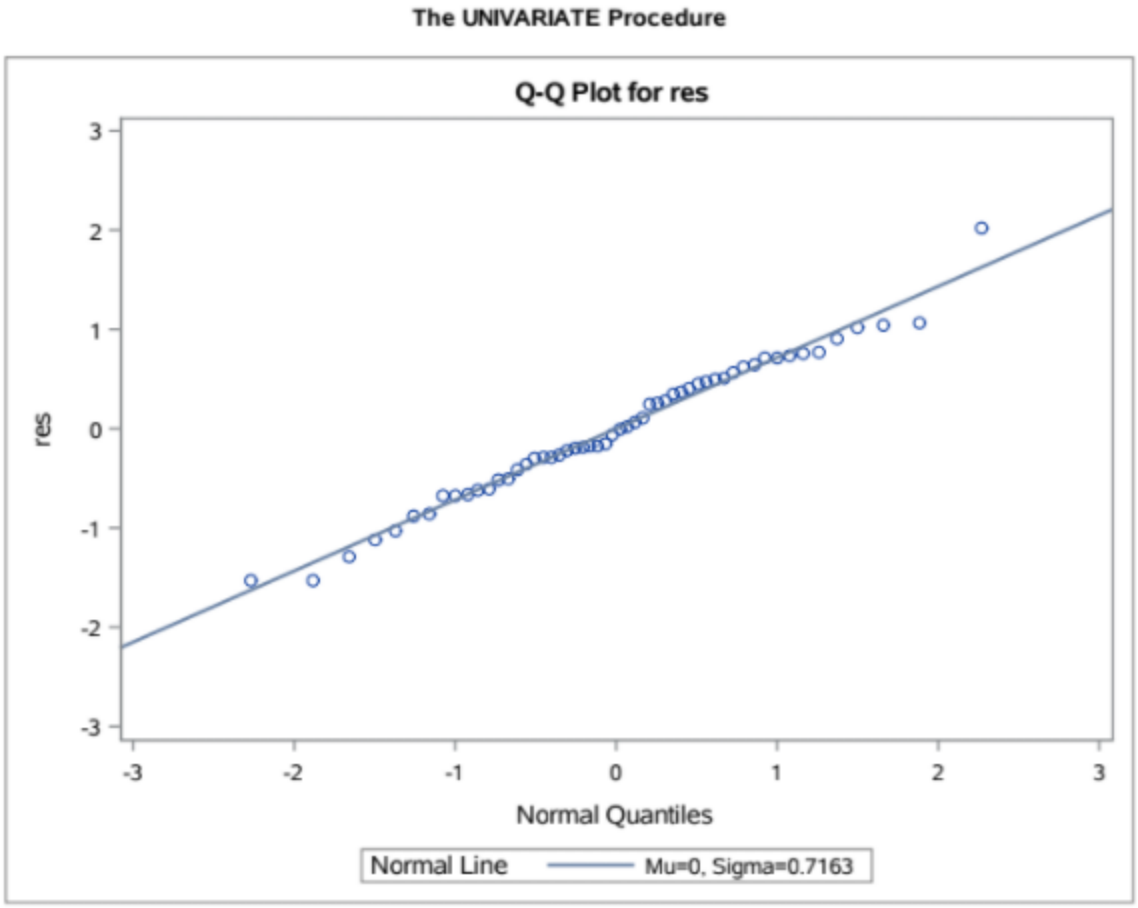

Figure 17: Q-Q plot for responses. Data points lie along line of best fit which indicates normal distribution.

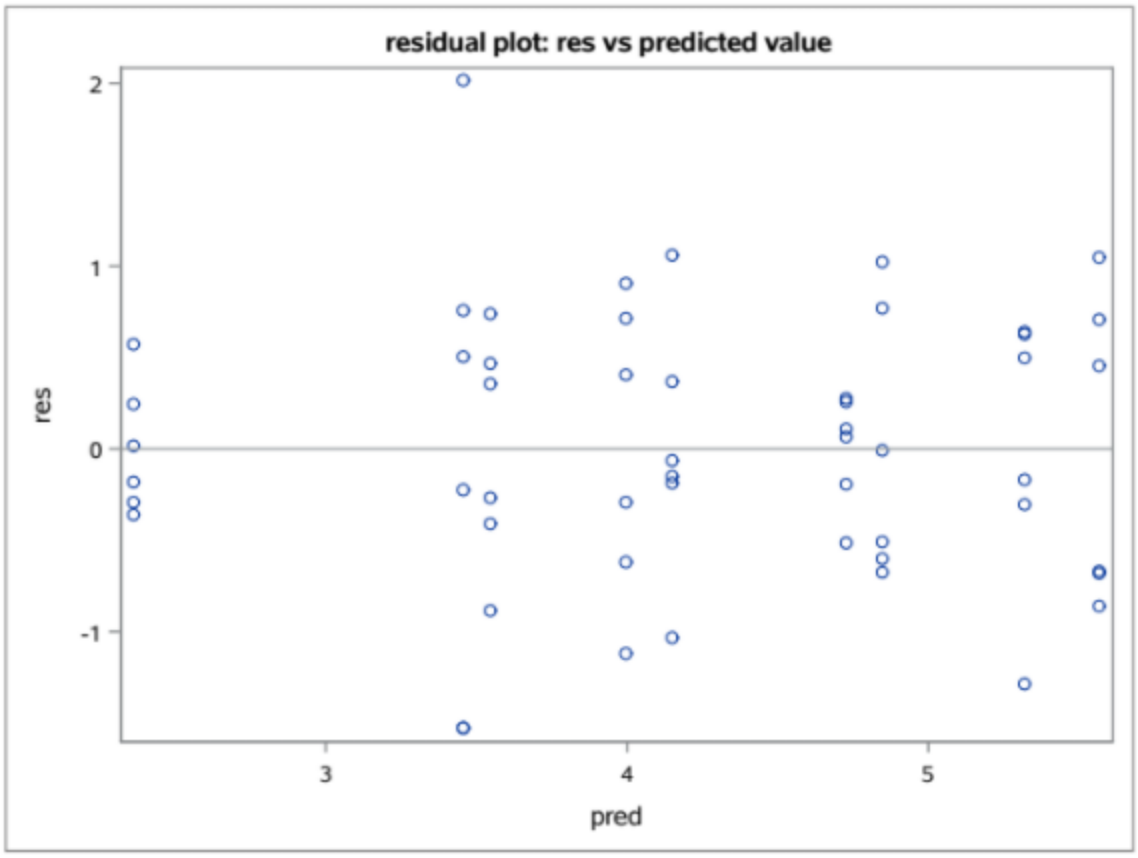

Figure 18: Residual plot vs predicted value. Data points indicate normality.

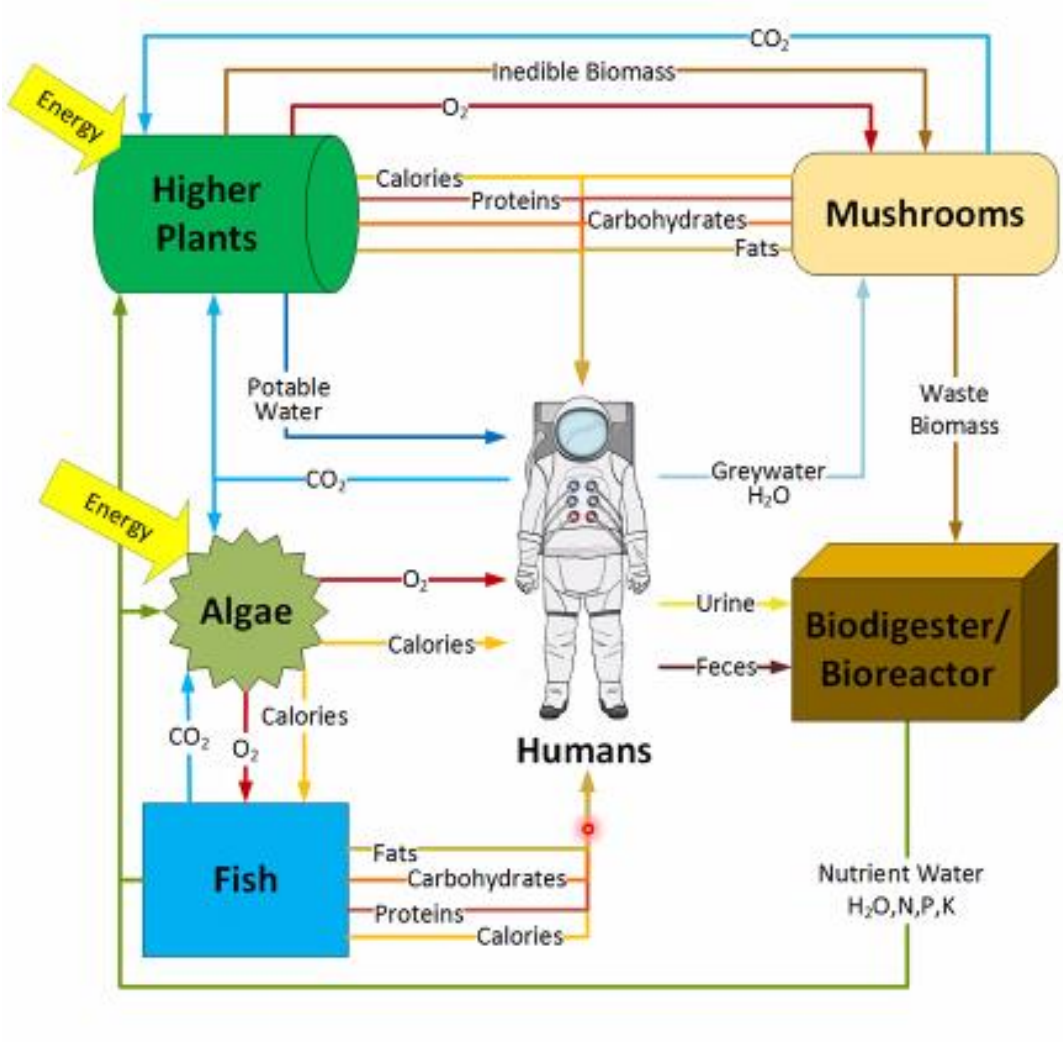

Figure 19: System level diagram of interaction between higher plants, mushrooms, algae, fish, biodigester/bioreactors, and humans in a BLSS (Gellenbeck et al., 2019)