

# Nutrient cycling with duckweed for the fertilization of root, fruit, leaf, and grain crops: impacts to plant-soil-leachate systems

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## SUPPLEMENTARY INFORMATION

Table 1. Initial average composite results of fertility tests performed on the soil used for each of the crops in the greenhouse experiment before adding the soil amendments.

Plant	Treatment	pH	% C	% TN	P (ppm)	K (ppm)	Mg (ppm)	Ca (ppm)	CEC (meq/100g)
Beet	Control	7.7	2.96	0.3	39	109	652	2001	15.9
	Fertilizer	7.5	3.18	0.32	53	109	686	2082	16.6
	Duckweed	7.6	3.23	0.33	54	167	693	2140	17.1
	Mix	7.5	3.13	0.32	47	117	601	1815	14.6
Kale	Control	7.7	3.03	0.31	38	92	652	1898	15.1
	Fertilizer	7.4	3.09	0.32	156	99	686	1967	16.0
	Duckweed	7.4	3.49	0.35	98	199	693	1796	14.6
	Mix	7.4	3.16	0.32	144	193	601	2097	17.1
Tomato	Control	7.7	3.06	0.31	34	56	622	1896	15.0
	Fertilizer	7.8	3.11	0.32	46	60	650	1974	15.6
	Duckweed	7.7	3.20	0.32	45	66	653	1976	15.7
	Mix	7.8	3.13	0.32	47	61	658	1979	15.7
Sorghum	Control	7.6	3.12	0.32	31	68	577	1808	14.0
	Fertilizer	7.5	3.14	0.32	45	78	688	2072	16.3
	Duckweed	7.6	3.10	0.32	46	112	714	2209	17.3
	Mix	7.5	3.10	0.32	44	95	693	2097	16.5

Table S2. Nutrient content of duckweed after collection from the Living Filter at Penn State University. Values are triplicate averages; error represents one standard deviation.

<b>Element s</b>	<b>Oven dried<sup>2</sup> duckweed (dry weight basis)</b>
C (%)	36.5 ± 0.4
N (%)	3.1 ± 0.2
P (%)	0.8 ± 0.0
K (%)	4.2 ± 0.2
Ca (%)	2.6 ± 0.2
Mg (%)	0.6 ± 0.0
Mn (ppm)	1666 ± 215
Fe (ppm)	1009 ± 146
Cu (ppm)	7.1 ± 0.5
B (ppm)	409 ± 11
Al (ppm)	550 ± 112
Zn (ppm)	64 ± 9
Na (ppm)	9321 ± 721

<sup>2</sup>Oven dried for 22 hours at 60°C.

Table S3. Leached masses of  $\text{NH}_4^+\text{-N}$ ,  $\text{NO}_3^-\text{-N}$ , TIN, and average percentage of TIN lost from pots containing beet, kale, tomato, and sorghum grown in a greenhouse experiment treated with control (no amendment), duckweed, fertilizer, and mix. Data are triplicate averages with one standard deviation from replicate pot tests. Different letters indicate significant differences among the treatments ( $p < 0.05$ ).

Plant	Treatment	$\text{NH}_4^+\text{-N}$ leached (kg/ha)	$\text{NO}_3^-\text{-N}$ leached (kg/ha)	TIN leached (kg/ha)	TIN Loss (%)
Beet	Control	$0.36 \pm 0.04$ (a)	$28.12 \pm 3.18$ (b)	$28.49 \pm 3.14$ (b)	-
	Fertilizer	$9.32 \pm 2.9$ (a)	$73.96 \pm 9.64$ (a)	$83.28 \pm 9.74$ (a)	$20.56 \pm 5.71$ (a)
	Duckweed	$5.01 \pm 0.71$ (ab)	$63.13 \pm 0.49$ (a)	$68.14 \pm 1.03$ (a)	$10.08 \pm 0.88$ (b)
	Mix	$6.27 \pm 0.61$ (a)	$69.09 \pm 6.75$ (a)	$75.35 \pm 6.19$ (a)	$14.8 \pm 3.61$ (ab)
	p-value	0.003	$< 0.001$	$< 0.001$	0.046
Kale	Control	$0.35 \pm 0.06$ (c)	$12.57 \pm 0.61$ (b)	$12.93 \pm 0.55$ (b)	-
	Fertilizer	$27.08 \pm 2.1$ (a)	$50.98 \pm 23.33$ (ab)	$78.05 \pm 21.23$ (a)	$11.04 \pm 4.3$ (a)
	Duckweed	$13.62 \pm 2.52$ (b)	$60.21 \pm 5.9$ (a)	$73.84 \pm 3.39$ (a)	$10.33 \pm 0.78$ (a)
	Mix	$16.82 \pm 1.86$ (b)	$46.81 \pm 7.8$ (ab)	$63.63 \pm 6.33$ (a)	$8.6 \pm 1.26$ (a)
	p-value	$< 0.001$	0.025	0.001	0.538
Tomato	Control	$0.24 \pm 0.08$ (b)	$11.67 \pm 2.87$ (b)	$11.91 \pm 2.81$ (b)	-
	Fertilizer	$0.68 \pm 0.21$ (a)	$21.77 \pm 2.56$ (ab)	$22.45 \pm 2.47$ (ab)	$3.09 \pm 1.59$ (a)
	Duckweed	$0.29 \pm 0.09$ (b)	$21.03 \pm 4.96$ (ab)	$21.33 \pm 4.98$ (ab)	$2.76 \pm 1.94$ (a)
	Mix	$0.3 \pm 0.03$ (ab)	$28.85 \pm 6.82$ (a)	$29.15 \pm 6.8$ (a)	$5.06 \pm 3.14$ (a)
	p-value	0.02	0.037	0.035	0.218
Sorghum	Control	$0.54 \pm 0.28$ (a)	$14.88 \pm 1.58$ (b)	$15.42 \pm 1.37$ (b)	-
	Fertilizer	$0.37 \pm 0.22$ (a)	$24.28 \pm 0.96$ (ab)	$24.65 \pm 1.18$ (ab)	$5.65 \pm 0.99$ (a)
	Duckweed	$0.62 \pm 0.21$ (a)	$26.01 \pm 5.66$ (a)	$26.63 \pm 5.58$ (a)	$6.87 \pm 4.33$ (a)
	Mix	$0.35 \pm 0.09$ (a)	$32.16 \pm 2.7$ (a)	$32.51 \pm 2.61$ (a)	$10.47 \pm 2.96$ (a)
	p-value	0.535	0.005	0.005	0.470

Table S4. Nutrient use efficiency and N and P present in the plant tissues of beet, kale, tomato, and sorghum grown in a greenhouse experiment treated with control (no amendment), duckweed, fertilizer, or mix. Data are singlet measurements of composite samples (n = 3).

<b>Plant</b>	<b>Treatment</b>	<b>%N</b>	<b>%P</b>	<b>% N use efficiency</b>	<b>% P use efficiency</b>
Beet	Control	1.56	0.36	-	-
	Fertilizer	1.75	0.35	44.28	50.82
	Duckweed	1.61	0.42	20.5	22.47
	Mix	1.59	0.43	27.03	58.91
Kale	Control	1.14	0.27	-	-
	Fertilizer	2.86	0.48	32.83	30.69
	Duckweed	2.83	0.53	17.78	11.37
	Mix	2.71	0.48	14.69	10.67
Tomato	Control	2.09	0.54	-	-
	Fertilizer	1.67	0.43	11.68	18.24
	Duckweed	1.69	0.42	13.64	11.93
	Mix	1.86	0.51	19.13	28.28
Sorghum	Control	1.93	0.32	-	-
	Fertilizer	1.75	0.30	10.35	12.83
	Duckweed	1.77	0.31	21.79	18.48
	Mix	1.75	0.29	17.15	13.90

## **ANOVA Results from Minitab:**

### **1. Ammonium leached** **a. BEET**

AMMONIUM

Ammonium One-way ANOVA: Beet\_Control, Beet\_Duckweed, Beet\_Fertilizer, Beet\_Mix

#### Method

Null hypothesis All means are equal  
Alternative hypothesis Not all means are equal  
Significance level  $\alpha = 0.05$

*Equal variances were assumed for the analysis.*

#### Factor Information

Factor Levels Values

Factor 4 Beet\_Control, Beet\_Duckweed, Beet\_Fertilizer, Beet\_Mix

#### Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	124.50	41.501	11.91	0.003
Error	8	27.87	3.484		
Total	11	152.37			

#### Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
1.86651	81.71%	74.85%	58.85%

#### Means

Factor	N	Mean	StDev	95% CI
Beet_Control	3	0.3633	0.0473	(-2.1217, 2.8483)
Beet_Duckweed	3	5.010	0.872	(2.525, 7.495)
Beet_Fertilizer	3	9.32	3.55	(6.83, 11.80)
Beet_Mix	3	6.263	0.741	(3.778, 8.748)

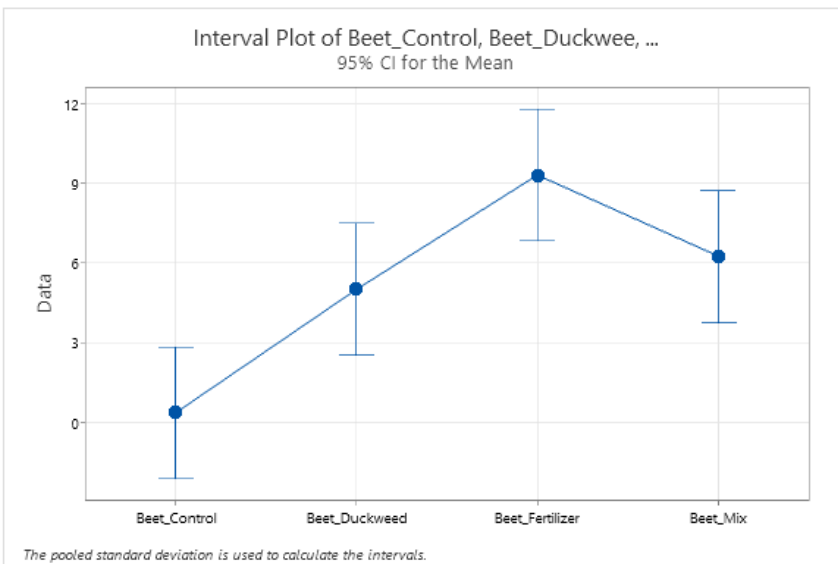
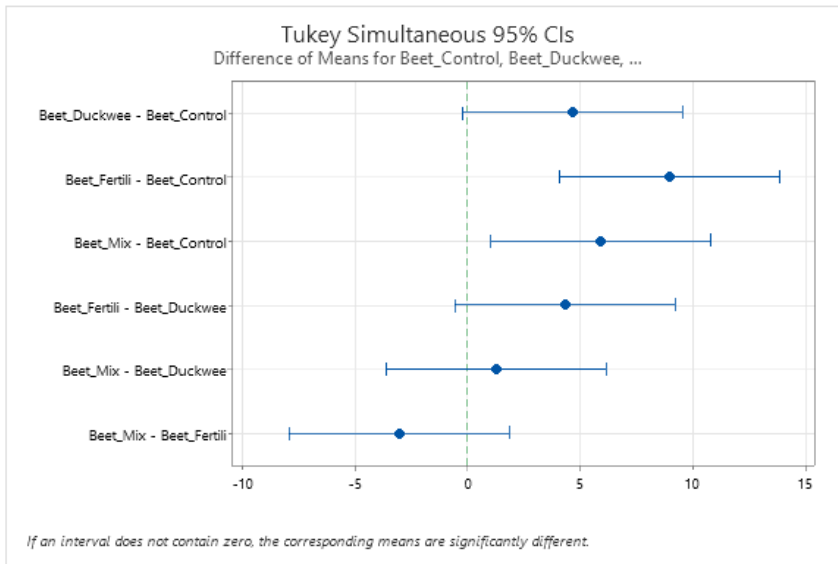
*Pooled StDev = 1.86651*

## Tukey Pairwise Comparisons

### Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Beet_Fertilizer	3	9.32	A
Beet_Mix	3	6.263	A
Beet_Duckweed	3	5.010	A B
Beet_Control	3	0.3633	B

Means that do not share a letter are significantly different.



b. KALE

AMMONIUM

One-way ANOVA: Kale\_Control, Kale\_Duckweed, Kale\_Fertilizer, Kale\_Mix

Method

Null hypothesis All means are equal  
Alternative hypothesis Not all means are equal  
Significance level  $\alpha = 0.05$

Equal variances were assumed for the analysis.

Factor Information

Factor Levels Values	
Factor	4 Kale_Control, Kale_Duckweed, Kale_Fertilizer, Kale_Mix

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	1093.72	364.573	68.14	0.000
Error	8	42.80	5.351		
Total	11	1136.52			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
2.31314	96.23%	94.82%	91.53%

Means

Factor	N	Mean	StDev	95% CI
Kale_Control	3	0.3500	0.0755	(-2.7296, 3.4296)
Kale_Duckweed	3	13.62	3.09	(10.54, 16.70)
Kale_Fertilizer	3	27.08	2.58	(24.00, 30.16)
Kale_Mix	3	16.83	2.28	(13.75, 19.91)

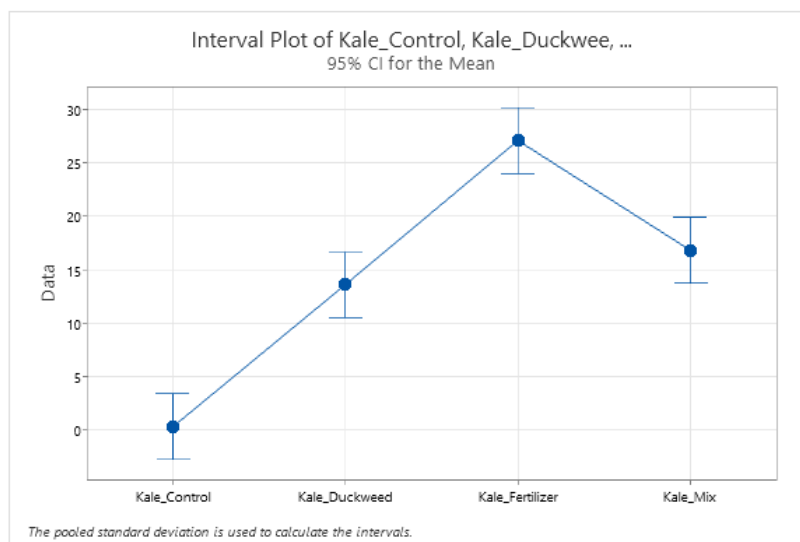
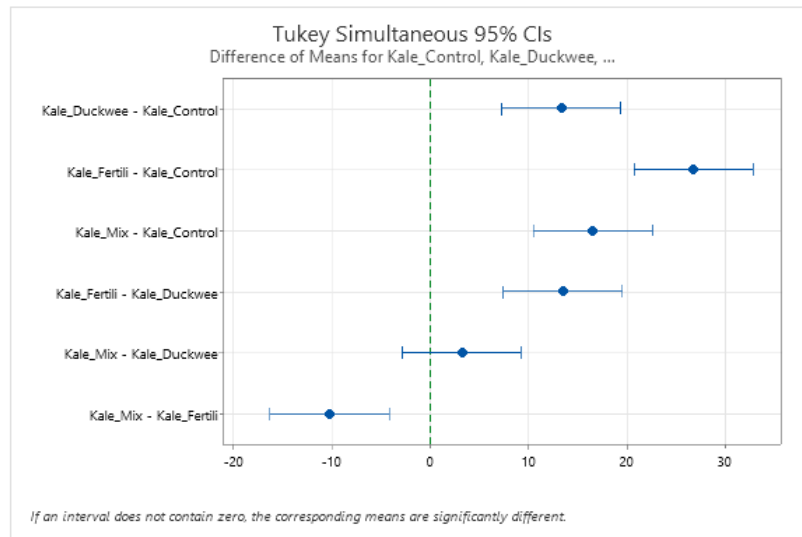
Pooled StDev = 2.31314

## Tukey Pairwise Comparisons

### Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Kale_Fertilizer	3	27.08	A
Kale_Mix	3	16.83	B
Kale_Duckweed	3	13.62	B
Kale_Control	3	0.3500	C

Means that do not share a letter are significantly different.



## c. TOMATO

AMMONIUM

### One-way ANOVA: Tomato\_Control, Tomato\_Duckweed, Tomato\_Fert

#### Method

Null hypothesis All means are equal  
Alternative hypothesis Not all means are equal  
Significance level  $\alpha = 0.05$

*Equal variances were assumed for the analysis.*

#### Factor Information

Factor Levels Values

Factor 4 Tomato\_Control, Tomato\_Duckweed, Tomato\_Fertilizer, Tomato\_Mix

#### Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	0.3824	0.12748	5.89	0.020
Error	8	0.1732	0.02165		
Total	11	0.5556			

#### Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.147139	68.83%	57.14%	29.86%

#### Means

Factor	N	Mean	StDev	95% CI
Tomato_Control	3	0.2333	0.0929	(0.0374, 0.4292)
Tomato_Duckweed	3	0.2900	0.1058	(0.0941, 0.4859)
Tomato_Fertilizer	3	0.683	0.255	(0.487, 0.879)
Tomato_Mix	3	0.3033	0.0416	(0.1074, 0.4992)

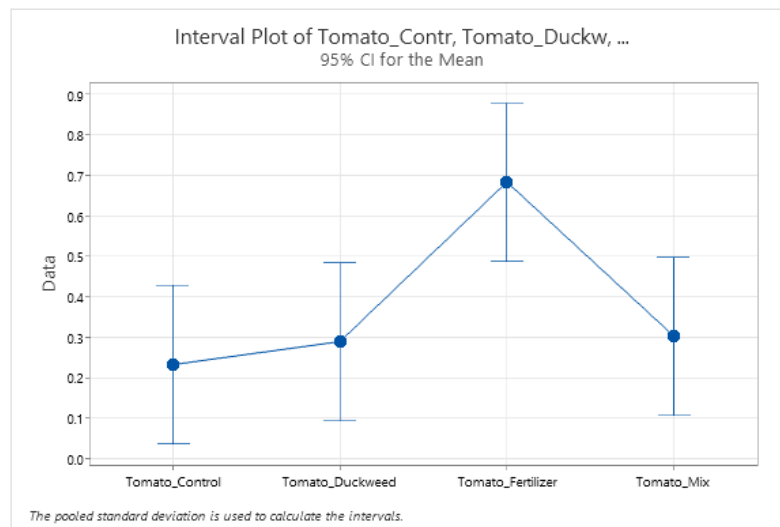
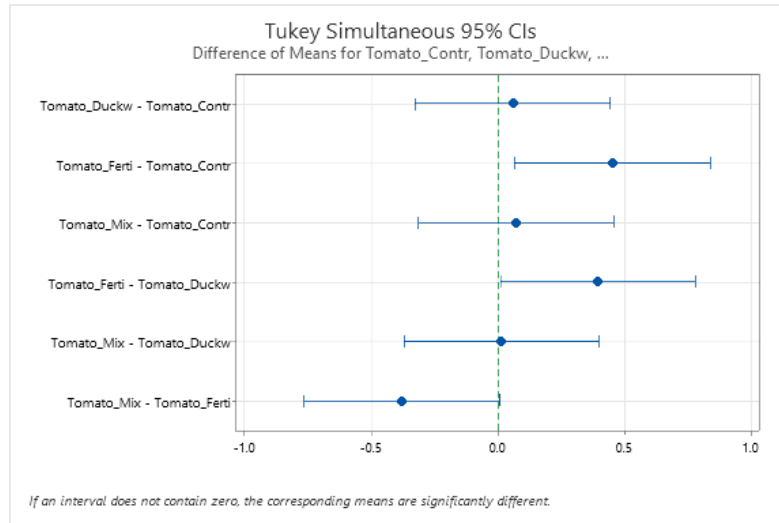
*Pooled StDev = 0.147139*

## Tukey Pairwise Comparisons

### Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Tomato_Fertilizer	3	0.683	A
Tomato_Mix	3	0.3033	A B
Tomato_Duckweed	3	0.2900	B
Tomato_Control	3	0.2333	B

Means that do not share a letter are significantly different.



d. SORGHUM

AMMONIUM

One-way ANOVA: Sorghum\_Control, Sorghum\_Duckweed, Sorghum\_Fert

Method

Null hypothesis All means are equal  
Alternative hypothesis Not all means are equal  
Significance level  $\alpha = 0.05$

Equal variances were assumed for the analysis.

Factor Information

Factor	Levels	Values
Factor	4	Sorghum_Control, Sorghum_Duckweed, Sorghum_Fertilizer, Sorghum_Mix

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	0.1584	0.05281	0.79	0.535
Error	8	0.5376	0.06720		
Total	11	0.6960			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.259230	22.76%	0.00%	0.00%

Means

Factor	N	Mean	StDev	95% CI
Sorghum_Control	3	0.537	0.350	(0.192, 0.882)
Sorghum_Duckweed	3	0.620	0.252	(0.275, 0.965)
Sorghum_Fertilizer	3	0.367	0.268	(0.022, 0.712)
Sorghum_Mix	3	0.3467	0.1026	(0.0015, 0.6918)

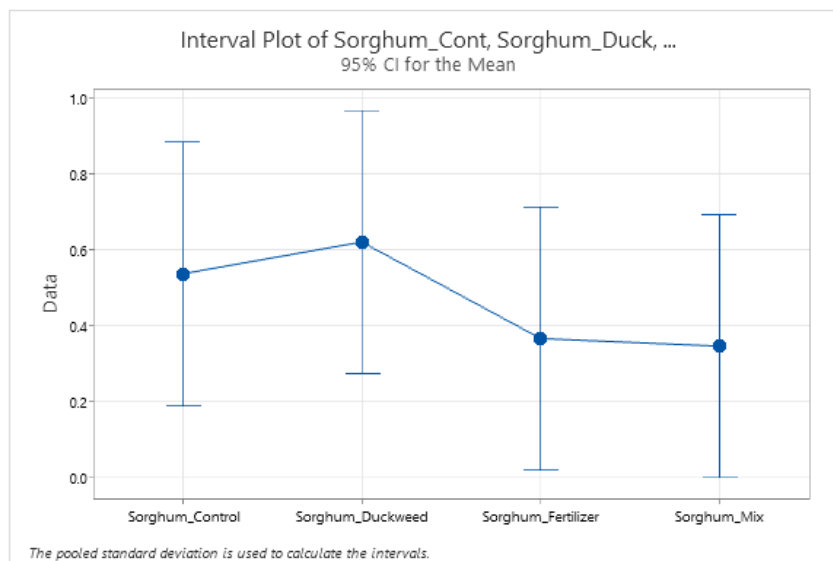
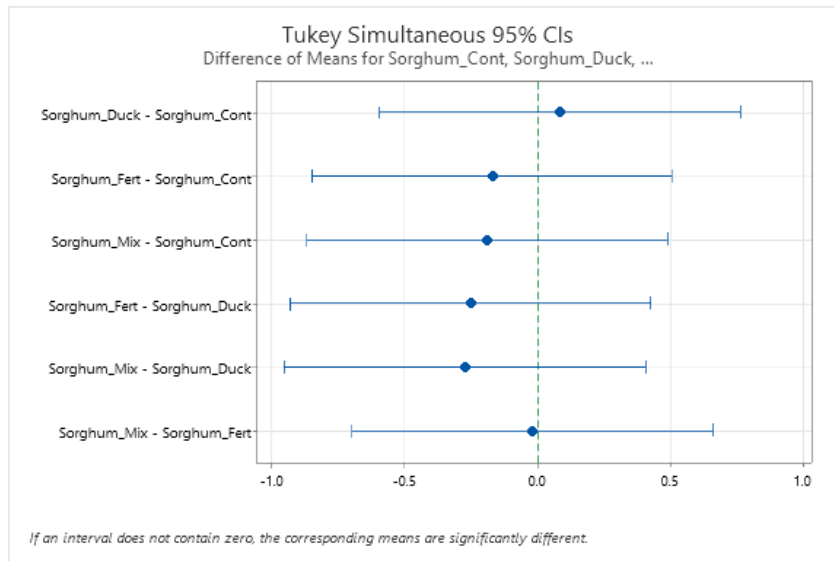
Pooled StDev = 0.259230

## Tukey Pairwise Comparisons

### Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Sorghum_Duckweed	3	0.620	A
Sorghum_Control	3	0.537	A
Sorghum_Fertilizer	3	0.367	A
Sorghum_Mix	3	0.3467	A

Means that do not share a letter are significantly different.



## 2. Total nitrate leached

### a. BEET

NITRATE

#### Nitrate ANOVA: Beet\_Control, Beet\_Duckweed, Beet\_Fertilizer, B

##### Method

Null hypothesis All means are equal  
Alternative hypothesis Not all means are equal  
Significance level  $\alpha = 0.05$

*Equal variances were assumed for the analysis.*

##### Factor Information

###### Factor Levels Values

Factor 4 Beet\_Control, Beet\_Duckweed, Beet\_Fertilizer, Beet\_Mix

##### Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	3885.6	1295.22	23.22	0.000
Error	8	446.3	55.79		
Total	11	4332.0			

##### Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
7.46917	89.70%	85.83%	76.82%

##### Means

Factor	N	Mean	StDev	95% CI
Beet_Control	3	28.12	3.89	(18.18, 38.07)
Beet_Duckweed	3	63.130	0.605	(53.185, 73.074)
Beet_Fertilizer	3	73.96	11.80	(64.02, 83.90)
Beet_Mix	3	69.09	8.27	(59.14, 79.03)

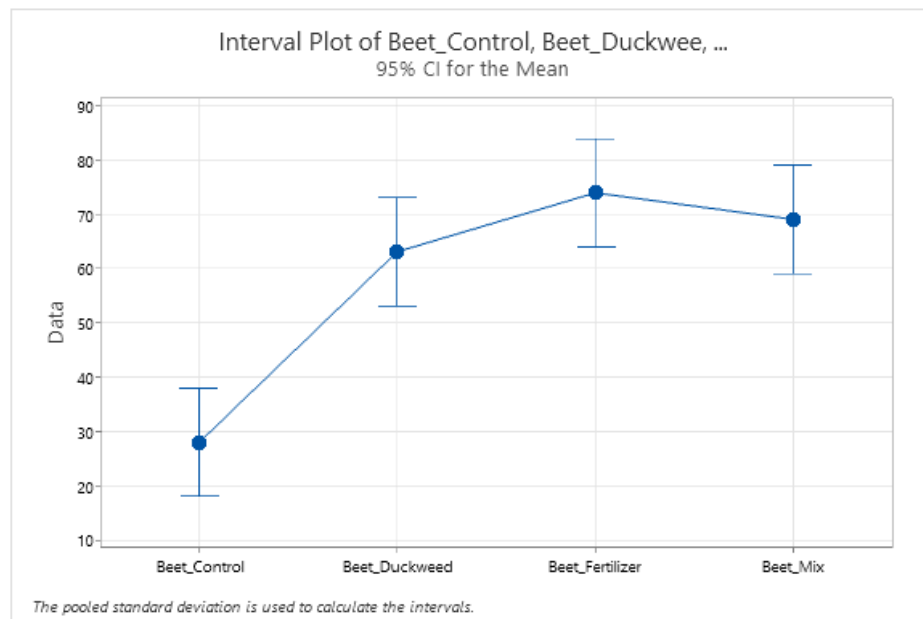
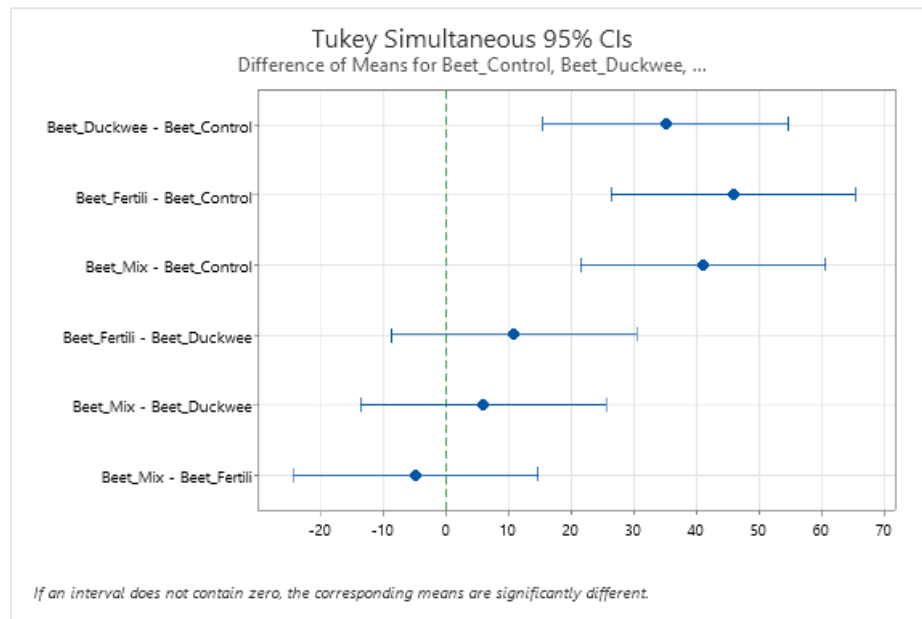
*Pooled StDev = 7.46917*

## Tukey Pairwise Comparisons

### Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Beet_Fertilizer	3	73.96	A
Beet_Mix	3	69.09	A
Beet_Duckweed	3	63.130	A
Beet_Control	3	28.12	B

Means that do not share a letter are significantly different.



## b. KALE

NITRATE

### One-way ANOVA: Kale\_Control, Kale\_Duckweed, Kale\_Fertilizer, Ka

#### Method

Null hypothesis All means are equal  
Alternative hypothesis Not all means are equal  
Significance level  $\alpha = 0.05$

*Equal variances were assumed for the analysis.*

#### Factor Information

Factor Levels Values

Factor 4 Kale\_Control, Kale\_Duckweed, Kale\_Fertilizer, Kale\_Mix

#### Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	3899	1299.7	5.41	0.025
Error	8	1921	240.1		
Total	11	5820			

#### Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
15.4948	67.00%	54.62%	25.74%

#### Means

Factor	N	Mean	StDev	95% CI
Kale_Control	3	12.575	0.753	(-8.055, 33.204)
Kale_Duckweed	3	60.21	7.23	(39.58, 80.84)
Kale_Fertilizer	3	51.0	28.6	(30.3, 71.6)
Kale_Mix	3	46.81	9.55	(26.18, 67.44)

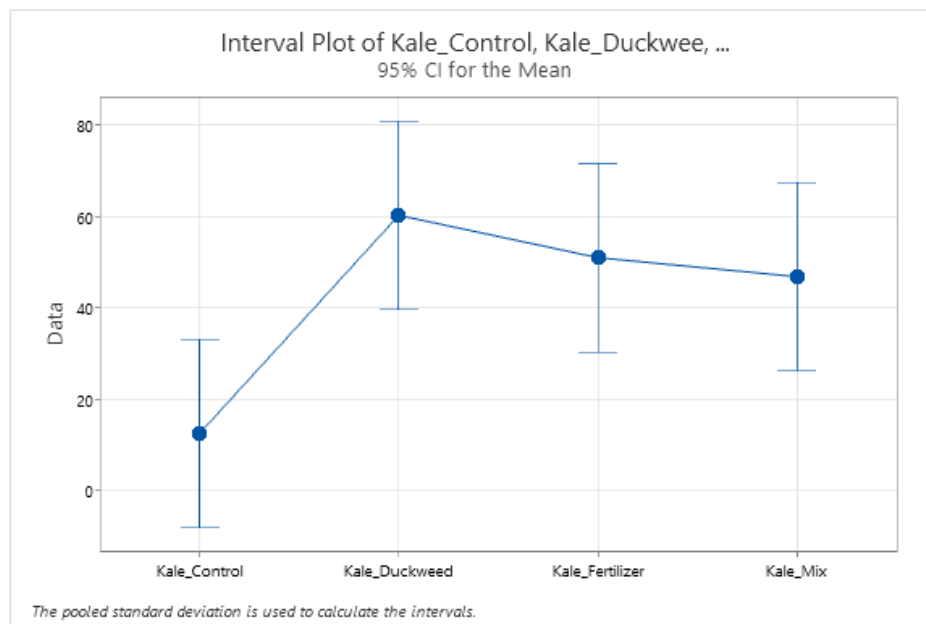
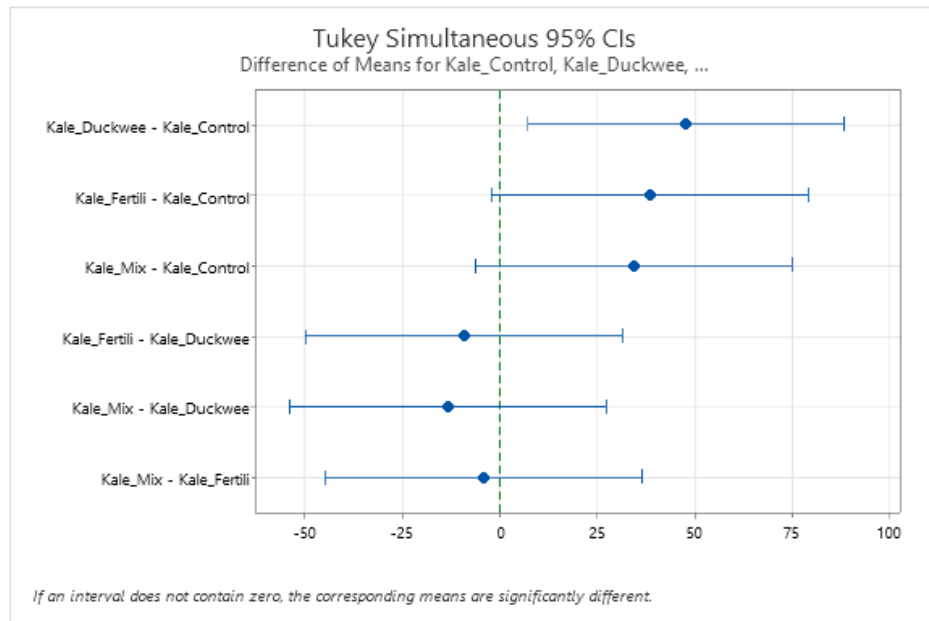
*Pooled StDev = 15.4948*

## Tukey Pairwise Comparisons

### Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Kale_Duckweed	3	60.21	A
Kale_Fertilizer	3	51.0	A B
Kale_Mix	3	46.81	A B
Kale_Control	3	12.575	B

Means that do not share a letter are significantly different.



### c. TOMATO

NITRATE

One-way ANOVA: Tomato\_Control, Tomato\_Duckweed, Tomato\_Fertilizer,

#### Method

Null hypothesis All means are equal  
Alternative hypothesis Not all means are equal  
Significance level  $\alpha = 0.05$

*Equal variances were assumed for the analysis.*

#### Factor Information

Factor Levels Values

Factor 4 Tomato\_Control, Tomato\_Duckweed, Tomato\_Fertilizer, Tomato\_Mix

#### Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	447.3	149.10	4.63	0.037
Error	8	257.7	32.21		
Total	11	705.0			

#### Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
5.67516	63.45%	49.75%	17.76%

#### Means

Factor	N	Mean	StDev	95% CI
Tomato_Control	3	11.67	3.51	(4.12, 19.23)
Tomato_Duckweed	3	21.03	6.07	(13.48, 28.59)
Tomato_Fertilizer	3	21.77	3.13	(14.21, 29.32)
Tomato_Mix	3	28.85	8.36	(21.30, 36.41)

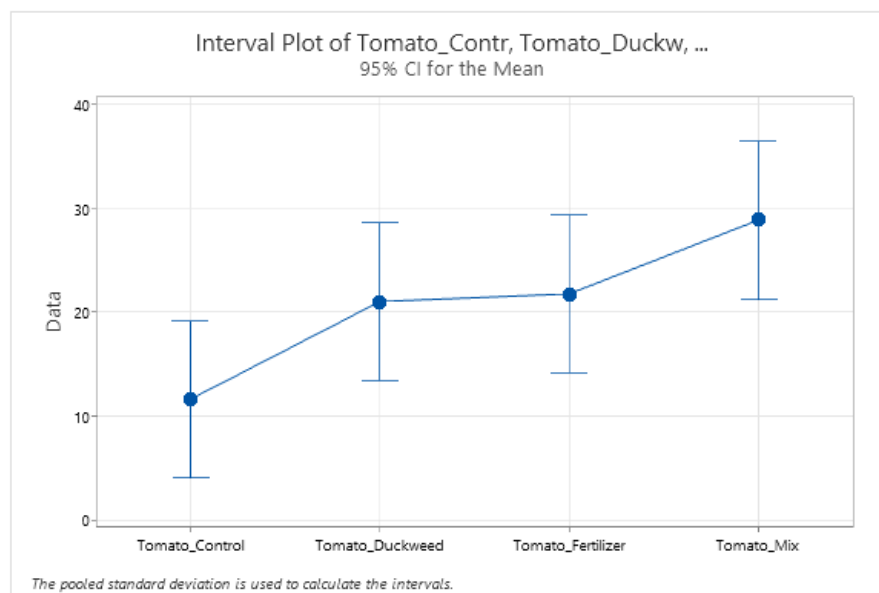
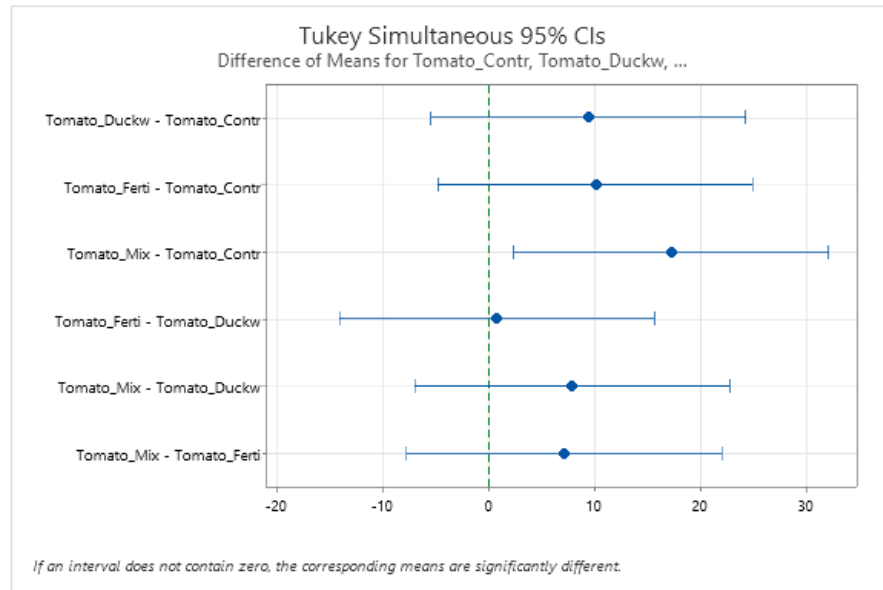
*Pooled StDev = 5.67516*

## Tukey Pairwise Comparisons

### Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Tomato_Mix	3	28.85	A
Tomato_Fertilizer	3	21.77	A B
Tomato_Duckweed	3	21.03	A B
Tomato_Control	3	11.67	B

Means that do not share a letter are significantly different.



## d. SORGHUM

NITRATE

### One-way ANOVA: Sorghum\_Control, Sorghum\_Duckweed, Sorghum\_Fertiliz

#### Method

Null hypothesis All means are equal  
Alternative hypothesis Not all means are equal  
Significance level  $\alpha = 0.05$

*Equal variances were assumed for the analysis.*

#### Factor Information

Factor Levels Values

Factor 4 Sorghum\_Control, Sorghum\_Duckweed, Sorghum\_Fertilizer, Sorghum\_Mix

#### Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	460.3	153.43	9.57	0.005
Error	8	128.3	16.03		
Total	11	588.6			

#### Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
4.00409	78.21%	70.03%	50.97%

#### Means

Factor	N	Mean	StDev	95% CI
Sorghum_Control	3	14.88	1.93	(9.55, 20.21)
Sorghum_Duckweed	3	26.01	6.93	(20.68, 31.34)
Sorghum_Fertilizer	3	24.276	1.176	(18.945, 29.607)
Sorghum_Mix	3	32.16	3.31	(26.83, 37.49)

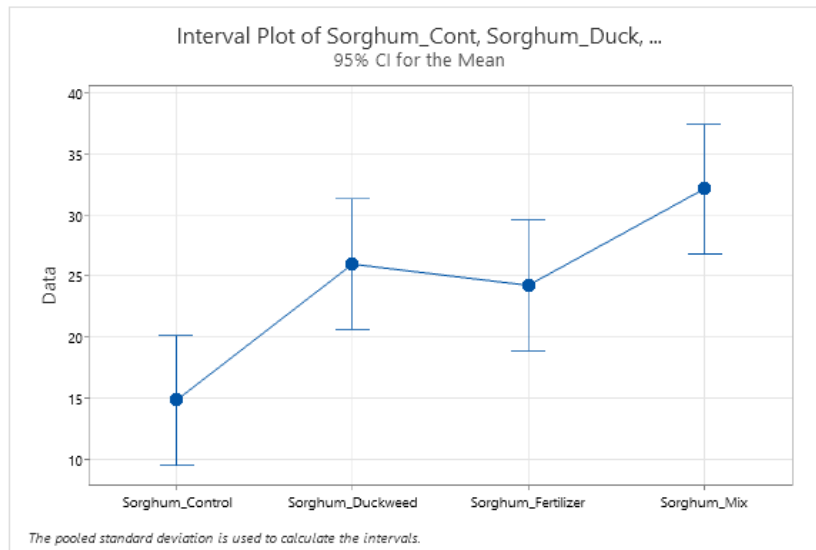
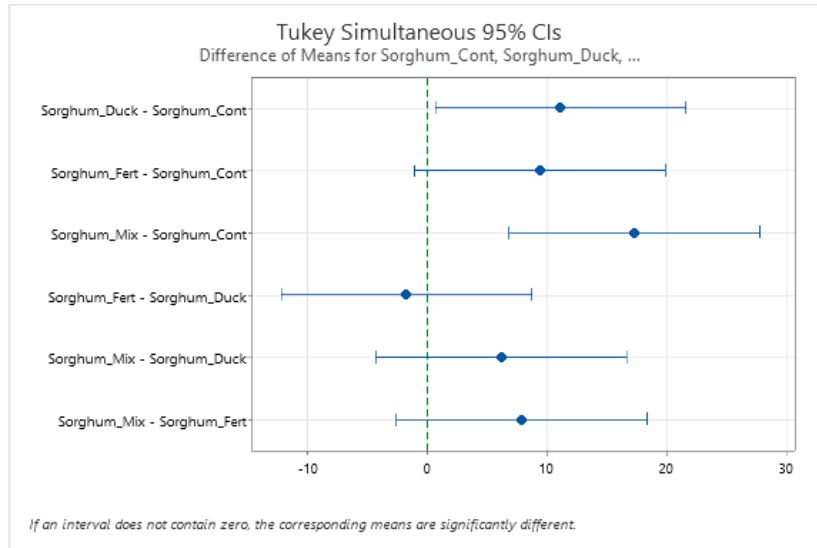
*Pooled StDev = 4.00409*

## Tukey Pairwise Comparisons

### Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Sorghum_Mix	3	32.16	A
Sorghum_Duckweed	3	26.01	A
Sorghum_Fertilizer	3	24.276	B
Sorghum_Control	3	14.88	B

Means that do not share a letter are significantly different.



### 3. Total inorganic nitrogen leached

#### a. BEET

TIN

TIN One-way ANOVA: Beet\_Control, Beet\_Duckweed, Beet\_Fertilizer, Beet\_Mix

#### Method

Null hypothesis All means are equal  
Alternative hypothesis Not all means are equal  
Significance level  $\alpha = 0.05$

*Equal variances were assumed for the analysis.*

#### Factor Information

Factor	Levels	Values
Factor	4	Beet_Control, Beet_Duckweed, Beet_Fertilizer, Beet_Mix

#### Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	5335.9	1778.63	32.91	0.000
Error	8	432.4	54.04		
Total	11	5768.2			

#### Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
7.35148	92.50%	89.69%	83.14%

#### Means

Factor	N	Mean	StDev	95% CI
Beet_Control	3	28.49	3.85	(18.70, 38.27)
Beet_Duckweed	3	68.133	1.259	(58.346, 77.921)
Beet_Fertilizer	3	83.28	11.93	(73.49, 93.06)
Beet_Mix	3	75.35	7.58	(65.57, 85.14)

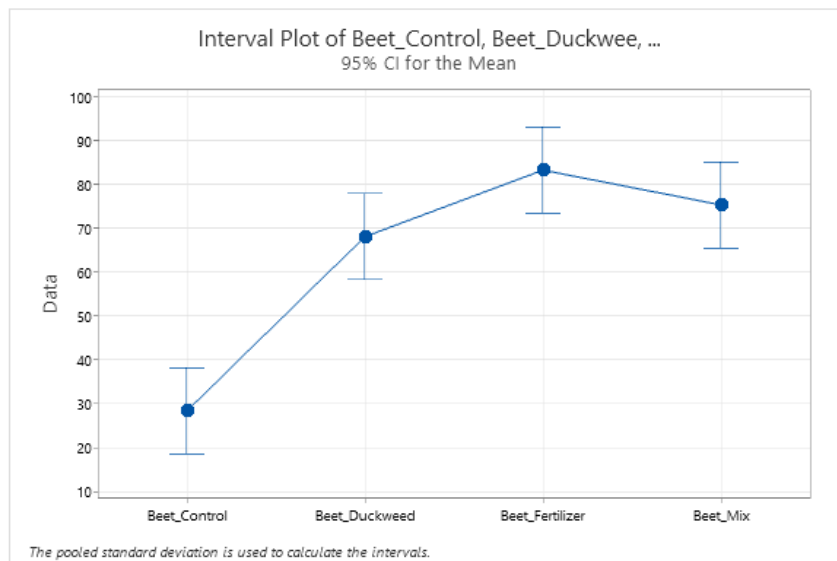
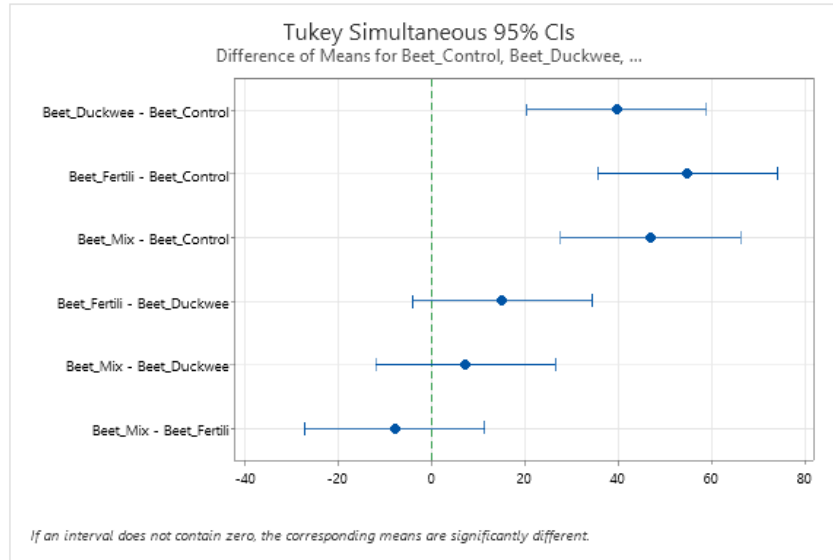
*Pooled StDev = 7.35148*

## Tukey Pairwise Comparisons

### Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Beet_Fertilizer	3	83.28	A
Beet_Mix	3	75.35	A
Beet_Duckweed	3	68.133	A
Beet_Control	3	28.49	B

Means that do not share a letter are significantly different.



## b. KALE

TIN

### One-way ANOVA: Kale\_Control, Kale\_Duckweed, Kale\_Fertilizer, Kale\_Mix

#### Method

Null hypothesis All means are equal  
Alternative hypothesis Not all means are equal  
Significance level  $\alpha = 0.05$

*Equal variances were assumed for the analysis.*

#### Factor Information

Factor	Levels	Values
Factor	4	Kale_Control, Kale_Duckweed, Kale_Fertilizer, Kale_Mix

#### Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	8139	2713.0	14.39	0.001
Error	8	1509	188.6		
Total	11	9647			

#### Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
13.7319	84.36%	78.50%	64.82%

#### Means

Factor	N	Mean	StDev	95% CI
Kale_Control	3	12.927	0.681	(-5.356, 31.209)
Kale_Duckweed	3	73.83	4.16	(55.55, 92.12)
Kale_Fertilizer	3	78.1	26.0	(59.8, 96.3)
Kale_Mix	3	63.63	7.75	(45.35, 81.91)

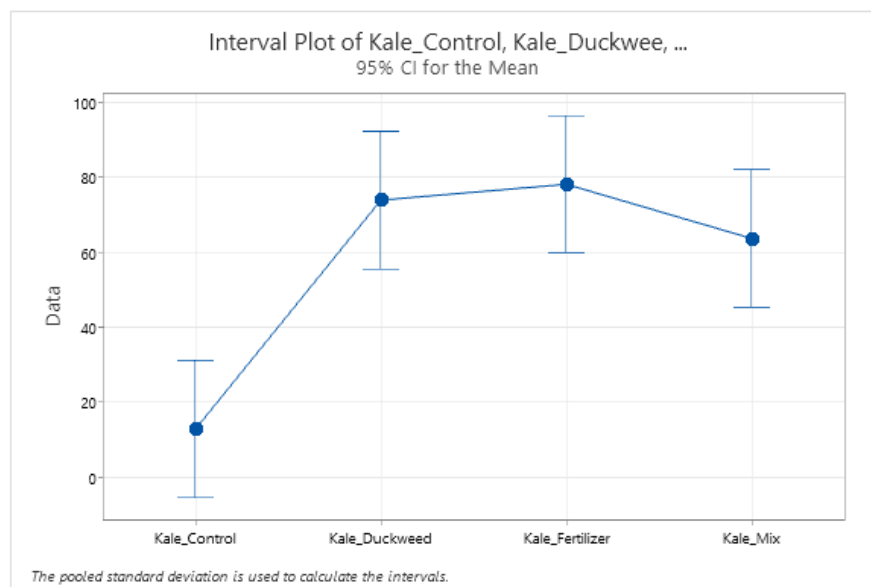
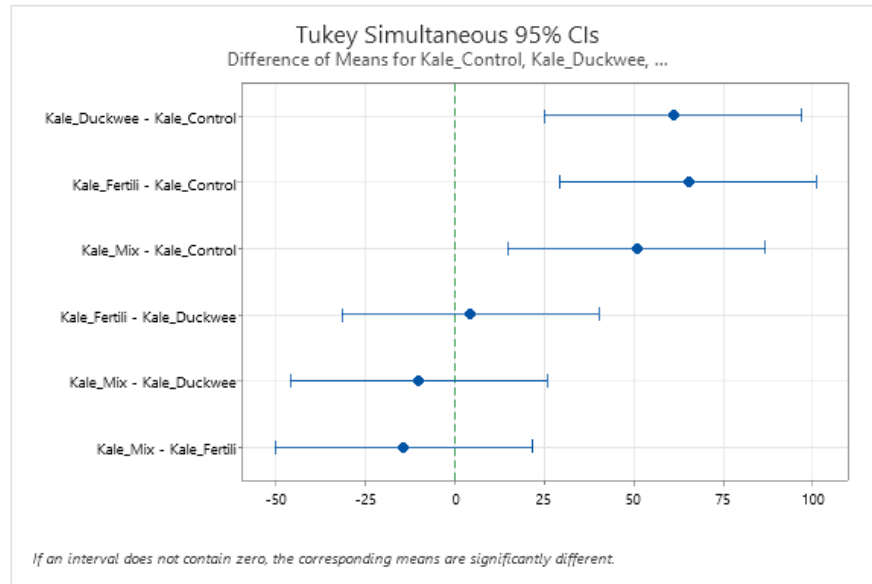
*Pooled StDev = 13.7319*

## Tukey Pairwise Comparisons

### Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Kale_Fertilizer	3	78.1	A
Kale_Duckweed	3	73.83	A
Kale_Mix	3	63.63	A
Kale_Control	3	12.927	B

Means that do not share a letter are significantly different.



c. TOMATO

TIN  
One-way ANOVA: Tomato\_Control, Tomato\_Duckweed, Tomato\_Fertilizer, Tomato\_Mix

Method

Null hypothesis All means are equal  
Alternative hypothesis Not all means are equal  
Significance level  $\alpha = 0.05$   
  
*Equal variances were assumed for the analysis.*

Factor Information

Factor	Levels	Values
Factor	4	Tomato_Control, Tomato_Duckweed, Tomato_Fertilizer, Tomato_Mix

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	453.4	151.13	4.74	0.035
Error	8	255.3	31.91		
Total	11	708.7			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
5.64893	63.98%	50.47%	18.95%

Means

Factor	N	Mean	StDev	95% CI
Tomato_Control	3	11.91	3.44	(4.39, 19.43)
Tomato_Duckweed	3	21.33	6.10	(13.81, 28.85)
Tomato_Fertilizer	3	22.45	3.03	(14.93, 29.97)
Tomato_Mix	3	29.15	8.33	(21.63, 36.67)

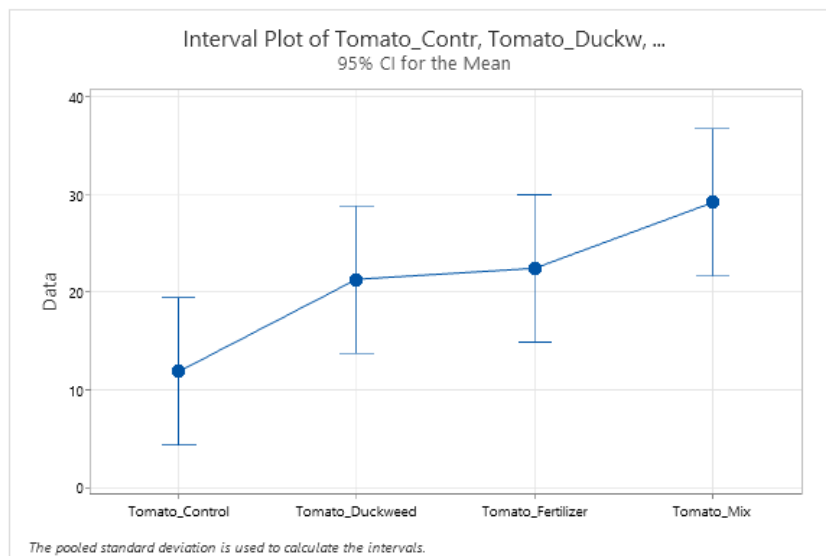
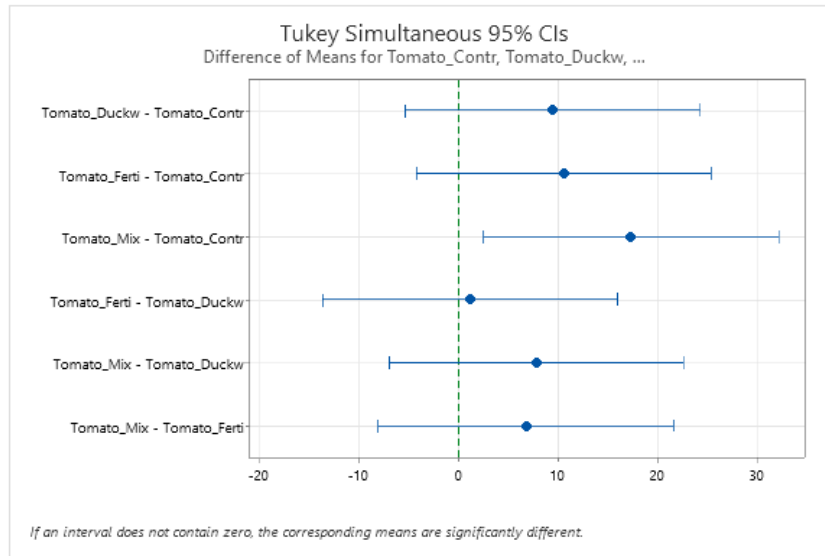
*Pooled StDev = 5.64893*

## Tukey Pairwise Comparisons

### Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Tomato_Mix	3	29.15	A
Tomato_Fertilizer	3	22.45	A B
Tomato_Duckweed	3	21.33	A B
Tomato_Control	3	11.91	B

Means that do not share a letter are significantly different.



d. SORGHUM

TIN

One-way ANOVA: Sorghum\_Control, Sorghum\_Duckweed, Sorghum\_Fertilizer, Sorghum\_Mix

Method

Null hypothesis All means are equal  
Alternative hypothesis Not all means are equal  
Significance level  $\alpha = 0.05$

Equal variances were assumed for the analysis.

Factor Information

Factor	Levels	Values
Factor	4	Sorghum_Control, Sorghum_Duckweed, Sorghum_Fertilizer, Sorghum_Mix

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	3	452.2	150.74	9.74	0.005
Error	8	123.7	15.47		
Total	11	576.0			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.93302	78.51%	70.46%	51.66%

Means

Factor	N	Mean	StDev	95% CI
Sorghum_Control	3	15.423	1.681	(10.187, 20.660)
Sorghum_Duckweed	3	26.63	6.84	(21.39, 31.87)
Sorghum_Fertilizer	3	24.643	1.442	(19.407, 29.880)
Sorghum_Mix	3	32.51	3.20	(27.27, 37.75)

Pooled StDev = 3.93302

## Tukey Pairwise Comparisons

### Grouping Information Using the Tukey Method and 95% Confidence

Factor	N	Mean	Grouping
Sorghum_Mix	3	32.51	A
Sorghum_Duckweed	3	26.63	A
Sorghum_Fertilizer	3	24.64	A B
Sorghum_Control	3	15.42	B

Means that do not share a letter are significantly different.

