Wild Rice Study - Hydroponic Tests
Summary of analysis of variance tests
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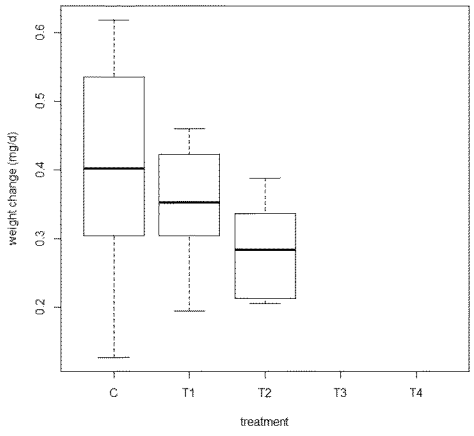
Data description

- treatment = categories describing the 5 experimental sulfide concentrations (Control, Treatment1, Treatment2, Treatment3, Treatment 4)
- mean sulfide = time weighted mean sulfide concentration (ug/L)
- weight change = (final weight – initial weight)/10 days
- test = categories describing the 3 experiments (RangeFinder, Definitive1, Definitive2)

1. **ANOVA: All 3 tests**
   Y = weight change
   X1 = treatment
   X2 = test




```
          Df   Sum Sq  Mean Sq F value   Pr(>F)
treatment  2 0.057489 0.028745  3.6670 0.042223 *
test       2 0.120655 0.060327  7.6962 0.002924 **
Residuals 22 0.172450 0.007839
```

Tukey multiple comparisons of means
95% family-wise confidence level
Fit: aov(formula = weight_change_mgd.1 ~ treatment + test, data = dataC12)
$treatment

	diff	lwr	upr	p adj
2-1	-0.06936667	-0.174210761	0.03547743	0.2419260
C-1	0.04260000	-0.062244095	0.14744409	0.5719733
C-2	**0.11196667**	**0.007122572**	**0.21681076**	**0.0349004**

$test

	diff	lwr	upr	p adj
definitive2-definitive1	-0.09144444	-0.19628854	0.01339965	0.0950245
rangefinder-definitive1	0.07191111	-0.03293298	0.17675521	0.2192241
rangefinder-definitive2	0.16335556	0.05851146	0.26819965	0.0020638

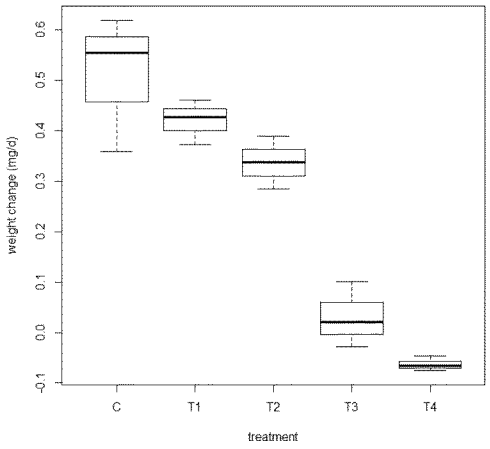
Multiple Comparisons of Means: Dunnett Contrasts
Fit: aov(formula = weight_change_mgd.1 ~ treatment + test, data = dataC12)
Linear Hypotheses:

	Estimate	Std. Error	t value	Pr(>|t|)
T1 - C == 0	-0.04260	0.04174	-1.021	0.4997
T2 - C == 0	**-0.11197**	**0.04174**	**-2.683**	**0.0252 ***

2. ANOVA: Range Finder

Y = weight change 1

X = treatment




```
          Df Sum Sq Mean Sq F value   Pr(>F)
treatment  4 0.7510 0.18774   34.31 8.17e-06 ***
Residuals 10 0.0547 0.00547
```

Tukey multiple comparisons of means

95% family-wise confidence level

Fit: aov(formula = weight_change_mgd.1 ~ treatment, data = range)

$treatment

	diff	lwr	upr	p adj
2-1	-0.08330000	-0.28206416	0.1154642	0.6528521
3-1	-0.38926667	-0.58803082	-0.1905025	0.0005472
4-1	-0.48293333	-0.68169749	-0.2841692	0.0000898
C-1	0.09066667	-0.10809749	0.2894308	0.5838846
3-2	-0.30596667	-0.50473082	-0.1072025	0.0034548
4-2	-0.39963333	-0.59839749	-0.2008692	0.0004421
C-2	**0.17396667**	**-0.02479749**	**0.3727308**	**0.0941846**
4-3	-0.09366667	-0.29243082	0.1050975	0.5560474
C-3	0.47993333	0.28116918	0.6786975	0.0000948
C-4	0.57360000	0.37483584	0.7723642	0.0000196

Multiple Comparisons of Means: Dunnett Contrasts

Fit: aov(formula = weight_change_mgd.1 ~ treatment, data = range)

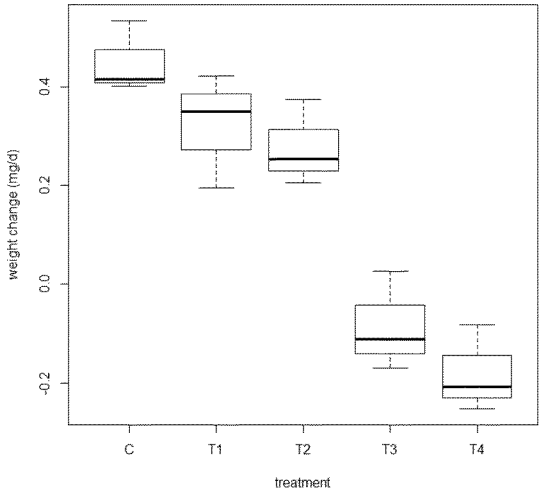
Linear Hypotheses:

	Estimate	Std. Error	t value	Pr(>|t|)
T1 - C == 0	-0.09067	0.06039	-1.501	0.414
T2 - C == 0	**-0.17397**	**0.06039**	**-2.880**	**0.051 .**
T3 - C == 0	-0.47993	0.06039	-7.947	<0.001 ***
T4 - C == 0	-0.57360	0.06039	-9.498	<0.001 ***

3. ANOVA: Definitive 1

Y = weight change

X = treatment

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          Df Sum Sq Mean Sq F value  Pr(>F)
treatment  4 0.9039 0.22598   25.41 3.2e-05 ***
Residuals 10 0.0889 0.00889
```

Tukey multiple comparisons of means

95% family-wise confidence level

Fit: aov(formula = weight_change_mgd.1 ~ treatment, data = definitive1)

$treatment

	diff	lwr	upr	p adj
2-1	-0.04526667	-0.29869262	0.2081593	0.9738906
3-1	-0.40796667	-0.66139262	-0.1545407	0.0024935
4-1	-0.50383333	-0.75725928	-0.2504074	0.0004845
C-1	0.12810000	-0.12532595	0.3815260	0.4943882
3-2	-0.36270000	-0.61612595	-0.1092740	0.0057700
4-2	-0.45856667	-0.71199262	-0.2051407	0.0010257
C-2	**0.17336667**	**-0.08005928**	**0.4267926**	**0.2371009**
4-3	-0.09586667	-0.34929262	0.1575593	0.7275598
C-3	0.53606667	0.28264072	0.7894926	0.0002911
C-4	0.63193333	0.37850738	0.8853593	0.0000717

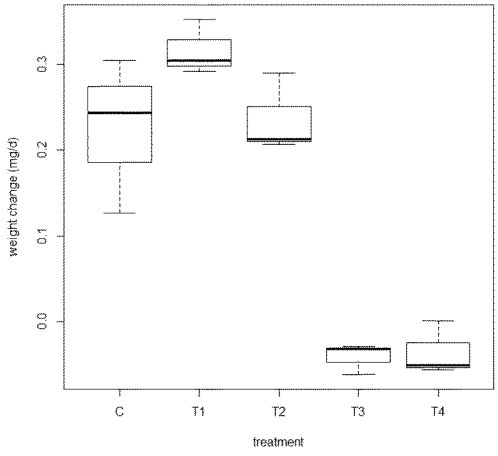
Multiple Comparisons of Means: Dunnett Contrasts

Fit: aov(formula = weight_change_mgd.1 ~ treatment, data = definitive1)

Linear Hypotheses:

	Estimate	Std. Error	t value	Pr(>|t|)
T1 - C == 0	-0.1281	0.0770	-1.664	0.334
T2 - C == 0	**-0.1734**	**0.0770**	**-2.251**	**0.140**
T3 - C == 0	-0.5361	0.0770	-6.962	<0.001 ***
T4 - C == 0	-0.6319	0.0770	-8.207	<0.001 ***

4. **ANOVA: Definitive 2**
   Y = weight change
   X = treatment

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          Df Sum Sq Mean Sq F value   Pr(>F)
treatment  4 0.3323 0.08307   32.87 9.96e-06 ***
Residuals 10 0.0253 0.00253
```

Tukey multiple comparisons of means
95% family-wise confidence level
Fit: aov(formula = weight_change_mgd.1 ~ treatment, data = definitive2)
$treatment

	diff	lwr	upr	p adj
2-1	-0.07953333	-0.2146195	0.05555284	0.3588150
3-1	-0.35666667	-0.4917528	-0.22158049	0.0000434
4-1	-0.35096667	-0.4860528	-0.21588049	0.0000500
C-1	-0.09096667	-0.2260528	0.04411951	0.2488850
3-2	-0.27713333	-0.4122195	-0.14204716	0.0003749
4-2	-0.27143333	-0.4065195	-0.13634716	0.0004444
C-2	**-0.01143333**	**-0.1465195**	**0.12365284**	**0.9984436**
4-3	0.00570000	-0.1293862	0.14078617	0.9999002
C-3	0.26570000	0.1306138	0.40078617	0.0005285
C-4	0.26000000	0.1249138	0.39508617	0.0006293

Multiple Comparisons of Means: Dunnett Contrasts
Fit: aov(formula = weight_change_mgd.1 ~ treatment, data = definitive2)
Linear Hypotheses:

	Estimate	Std. Error	t value	Pr(>|t|)
T1 - C == 0	0.09097	0.04105	2.216	0.148
T2 - C == 0	**0.01143**	**0.04105**	**0.279**	**0.995**
T3 - C == 0	-0.26570	0.04105	-6.473	<0.001 ***
T4 - C == 0	-0.26000	0.04105	-6.334	<0.001 ***

Analysis of Covariance

1. **All 3 tests**

   Y = weight change

   X1 = mean sulfide

   X2 = test

```
lm(formula = weight_change_mgd.1 ~ meansulfide_ugL * test, data = data)

Residuals:
    Min      1Q  Median      3Q     Max
-0.24883 -0.06824  0.02918  0.06920  0.22617

Coefficients:
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)              3.593e-01  4.067e-02   8.835 7.56e-11 ***
meansulfide_ugL         -4.831e-04  6.433e-05  -7.511 4.31e-09 ***
testdefinitive2         -9.644e-02  5.849e-02  -1.649 0.107235
testrangefinder          3.388e-02  5.571e-02   0.608 0.546642
meansulfide_ugL:testdefinitive2  1.361e-04  1.043e-04   1.305 0.199461
meansulfide_ugL:testrangefinder  2.860e-04  7.130e-05   4.011 0.000265 ***
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1182 on 39 degrees of freedom
Multiple R-squared:  0.7584,    Adjusted R-squared:  0.7274
F-statistic: 24.48 on 5 and 39 DF,  p-value: 4.494e-11
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