Biochar and Soil Microbial Inocula Effects on Plant Growth and C mineralization - with graphs

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Project Description:

Initial Setup

```
rm(list=ls())
setwd("~/GitHub/ECU-BGC-ME_2017")
se <- function(x, ...){sd(x, na.rm = TRUE)/sqrt(length(na.omit(x)))}
ci <- function(x, ...){1.96 * sd(x,na.rm = TRUE)}

# Code Dependencies
require("reshape")
```

```
## Loading required package: reshape
```

```
require("ggplot2")
```

```
## Loading required package: ggplot2
```

Input Data

```
data1 <- read.csv("../data/2017_BGE_ME_expt_DATA.csv", header=TRUE)
str(data1)
```

```
## 'data.frame':    60 obs. of  24 variables:
##  $ ID             : Factor w/ 60 levels "B0_C_P_R1","B0_C_P_R2",..: 10 11 12 34 35 36 58 59 60 22 ..
##  $ Biochar        : int  0 0 0 2 2 2 5 5 5 10 ...
##  $ Microbe        : Factor w/ 2 levels "Microbes","NoMicrobes": 1 1 1 1 1 1 1 1 1 1 ...
##  $ Plant          : Factor w/ 2 levels "NoPlant","Plant": 1 1 1 1 1 1 1 1 1 1 ...
##  $ Replicate      : Factor w/ 3 levels "rep1","rep2",..: 1 2 3 1 2 3 1 2 3 1 ...
##  $ Cmin           : num  15.4 17.9 16 18.2 14.7 ...
##  $ ShootMass_g    : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ RootMass_g     : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ PercentMoisture: num  9.5 23.7 25.9 180 32.3 ...
##  $ PercentC_Soil  : num  22.59 29.98 19.82 9.72 23.34 ...
##  $ X13C_Soil      : num  -27.9 -28.7 -27.3 -21.3 -26 ...
##  $ PercentN_Soil  : num  0.422 0.664 0.483 0.306 0.514 ...
##  $ X15N_Soil      : num  3.415 0.376 -0.466 3.627 1.457 ...
##  $ CNratio_Soil   : num  53.6 45.1 41 31.8 45.4 ...
##  $ PercentC_Roots : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ X13C_Roots     : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ PercentN_Roots : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ X15N_Roots     : num  NA NA NA NA NA NA NA NA NA NA ...
```

```
##  $ CNratio_Roots  : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ PercentC_Shoots: num  NA NA NA NA NA NA NA NA NA NA ...
##  $ X13C_Shoots    : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ PercentN_Shoot : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ X15N_Shoots    : num  NA NA NA NA NA NA NA NA NA NA ...
##  $ CNratio_Shoot  : num  NA NA NA NA NA NA NA NA NA NA ...
```

```
#NOTE: all parametric tests were run without testing for assumptions to simplify
#code for the class - so the 'proper' way to run these stats is to test for
#normality and homogeneity of variances or modeling fitting approaches
```

Data Analysis - Carbon Mineralization

```
# hyp testing and plot - 3-way ANOVA - all interactions
data.lm <- lm(Cmin~Biochar*Microbe*Plant, data=data1)
anova(data.lm)
```

```
## Analysis of Variance Table
##
## Response: Cmin
##                       Df Sum Sq Mean Sq F value   Pr(>F)
## Biochar                1  52.49  52.492  6.7381 0.012239 *
## Microbe                1  78.09  78.090 10.0239 0.002584 **
## Plant                  1  19.26  19.255  2.4717 0.121980
## Biochar:Microbe        1   3.71   3.705  0.4756 0.493489
## Biochar:Plant          1   3.86   3.861  0.4957 0.484552
## Microbe:Plant          1   0.82   0.819  0.1051 0.747060
## Biochar:Microbe:Plant  1   5.55   5.549  0.7123 0.402531
## Residuals             52 405.10   7.790
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(data.lm)
```

```
##
## Call:
## lm(formula = Cmin ~ Biochar * Microbe * Plant, data = data1)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -11.3992  -1.2088  -0.1563   1.2563   5.7432
##
## Coefficients:
##                                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)                        16.03311    1.03758  15.452   <2e-16
## Biochar                            -0.08763    0.10087  -0.869    0.389
## MicrobeNoMicrobes                  -1.93277    1.46736  -1.317    0.194
## PlantPlant                          0.25623    1.46736   0.175    0.862
## Biochar:MicrobeNoMicrobes          -0.01557    0.14266  -0.109    0.913
## Biochar:PlantPlant                 -0.15616    0.14266  -1.095    0.279
## MicrobeNoMicrobes:PlantPlant       -1.72738    2.07516  -0.832    0.409
## Biochar:MicrobeNoMicrobes:PlantPlant  0.17028    0.20175   0.844    0.403
##
```

```
## (Intercept)                          ***
## Biochar
## MicrobeNoMicrobes
## PlantPlant
## Biochar:MicrobeNoMicrobes
## Biochar:PlantPlant
## MicrobeNoMicrobes:PlantPlant
## Biochar:MicrobeNoMicrobes:PlantPlant
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.791 on 52 degrees of freedom
## Multiple R-squared:  0.2879, Adjusted R-squared:  0.192
## F-statistic: 3.003 on 7 and 52 DF,  p-value: 0.01003
```

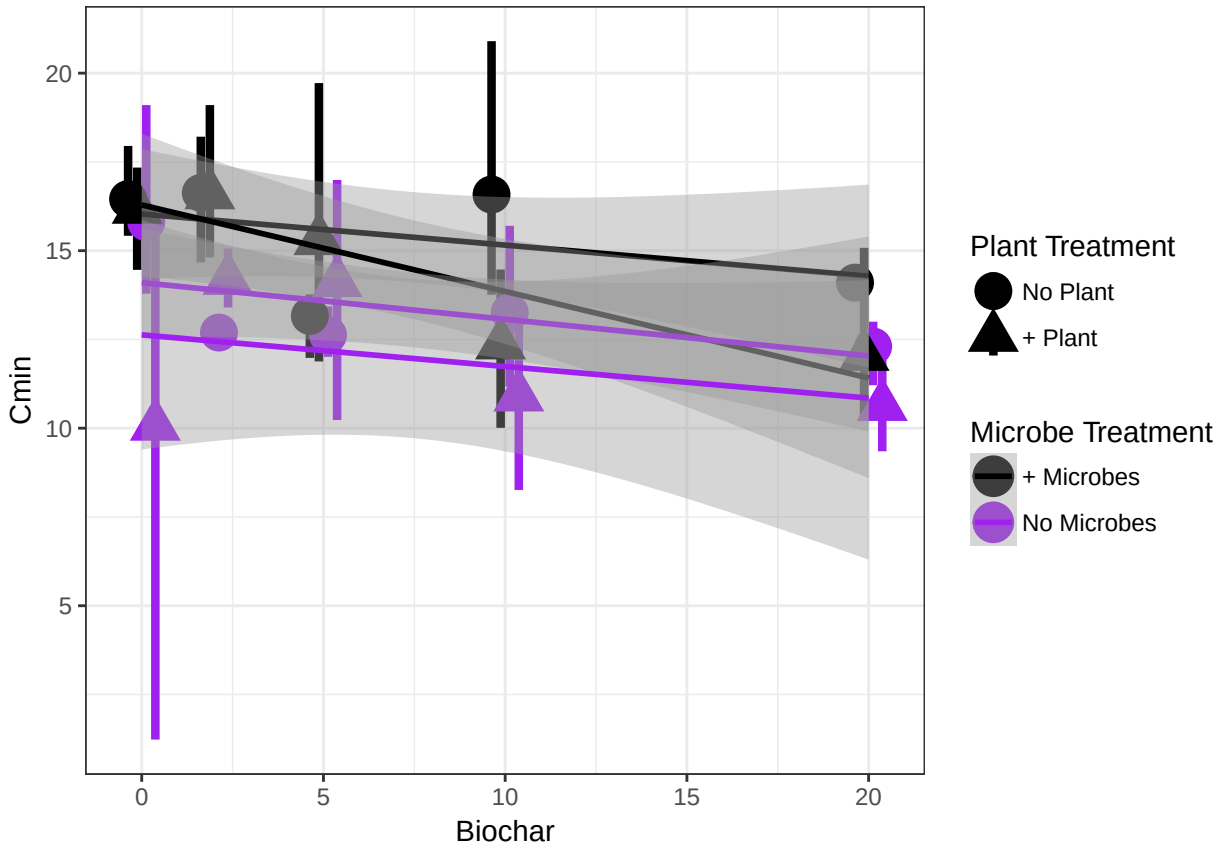
```
#only Biochar and Microbe main effects significant
data.lm2 <- lm(Cmin~Biochar+Microbe, data=data1)
anova(data.lm2)
```

```
## Analysis of Variance Table
##
## Response: Cmin
##           Df Sum Sq Mean Sq F value   Pr(>F)
## Biochar    1  52.49  52.492  6.8267 0.011463 *
## Microbe    1  78.09  78.090 10.1556 0.002335 **
## Residuals 57 438.29   7.689
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

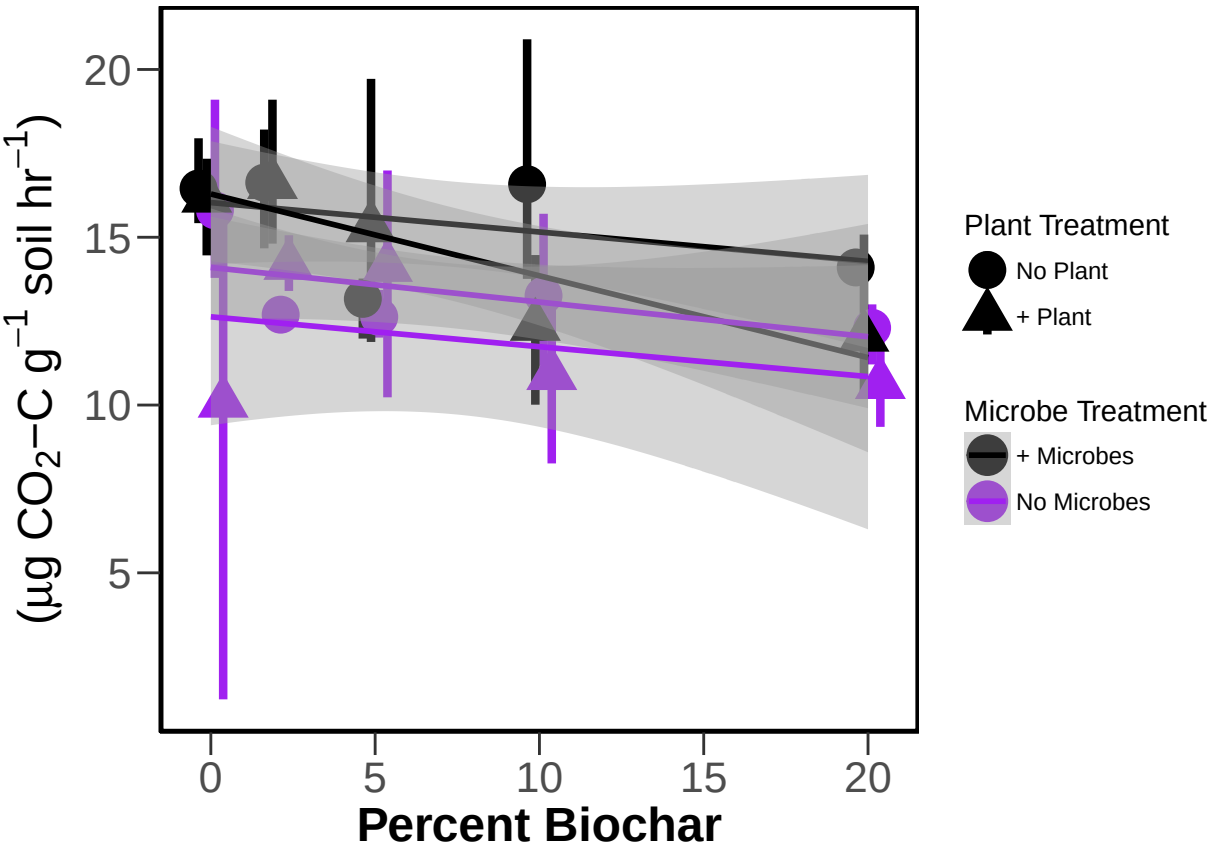
```
summary(data.lm2)
```

```
##
## Call:
## lm(formula = Cmin ~ Biochar + Microbe, data = data1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -12.392  -1.038   0.127   1.454   6.305
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)       15.90383    0.62754  25.343  < 2e-16 ***
## Biochar           -0.13092    0.05011  -2.613  0.01146 *
## MicrobeNoMicrobes -2.28167    0.71598  -3.187  0.00234 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.773 on 57 degrees of freedom
## Multiple R-squared:  0.2295, Adjusted R-squared:  0.2025
## F-statistic: 8.491 on 2 and 57 DF,  p-value: 0.000592
```

```
#graphing C mineralization by microbes only
p <- ggplot(data1, aes(x=Biochar, y=Cmin, color=as.factor(Microbe), shape=as.factor(Plant))) + scale_sha
p1=p+geom_smooth(method="lm")
p1 + theme_bw()
```




```
p1 + theme_bw() + theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(), axis.li
```




```
ggsave("../figures/Cmin.pdf", plot=last_plot(), device=NULL, path=NULL, scale=1, width=NA, height=NA, dp
```

```
## Saving 6.5 x 4.5 in image
```

Data Analysis - Shoot Biomass

```
data.lm <- lm(ShootMass_g~Biochar*Microbe, data=data1)
anova(data.lm)
```

```
## Analysis of Variance Table
##
## Response: ShootMass_g
##                  Df   Sum Sq  Mean Sq F value   Pr(>F)
## Biochar           1 0.011717 0.011717  1.4560 0.238440
## Microbe           1 0.064218 0.064218  7.9801 0.008964 **
## Biochar:Microbe   1 0.018520 0.018520  2.3014 0.141325
## Residuals        26 0.209230 0.008047
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary(data.lm)
```

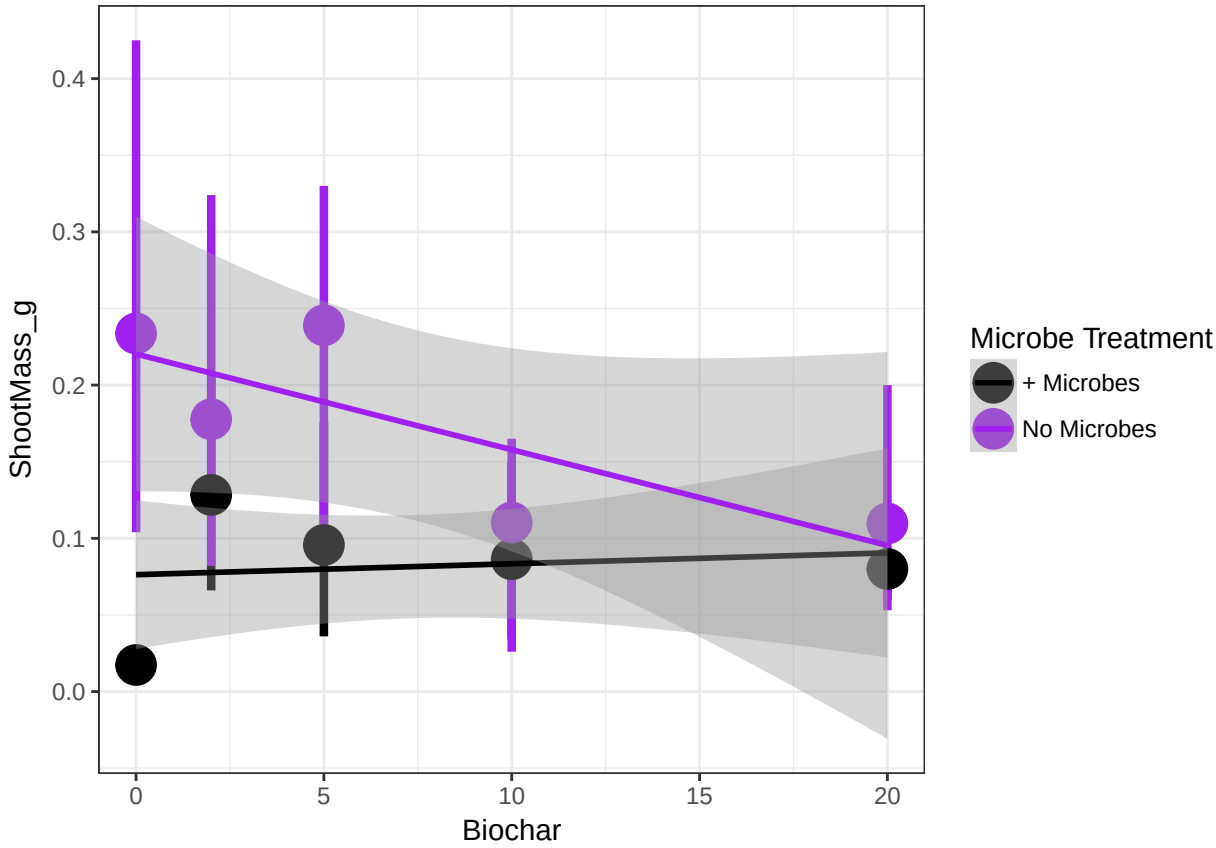
```
##
## Call:
## lm(formula = ShootMass_g ~ Biochar * Microbe, data = data1)
##
```

```
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.13183 -0.05455 -0.01476  0.05879  0.20473
##
## Coefficients:
##                              Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 0.0762675  0.0333478   2.287  0.03058 *
## Biochar                     0.0007116  0.0032421   0.219  0.82798
## MicrobeNoMicrobes           0.1440047  0.0471609   3.053  0.00517 **
## Biochar:MicrobeNoMicrobes -0.0069556  0.0045850  -1.517  0.14132
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.08971 on 26 degrees of freedom
##   (30 observations deleted due to missingness)
## Multiple R-squared:  0.311,  Adjusted R-squared:  0.2315
## F-statistic: 3.912 on 3 and 26 DF,  p-value: 0.01976
```

```
#graphing shoot biomass microbes x biochar
p <- ggplot(data1, aes(x=Biochar, y=ShootMass_g, color=as.factor(Microbe)))+ scale_color_manual(name="M
p1=p+geom_smooth(method="lm")
p1 + theme_bw()
```

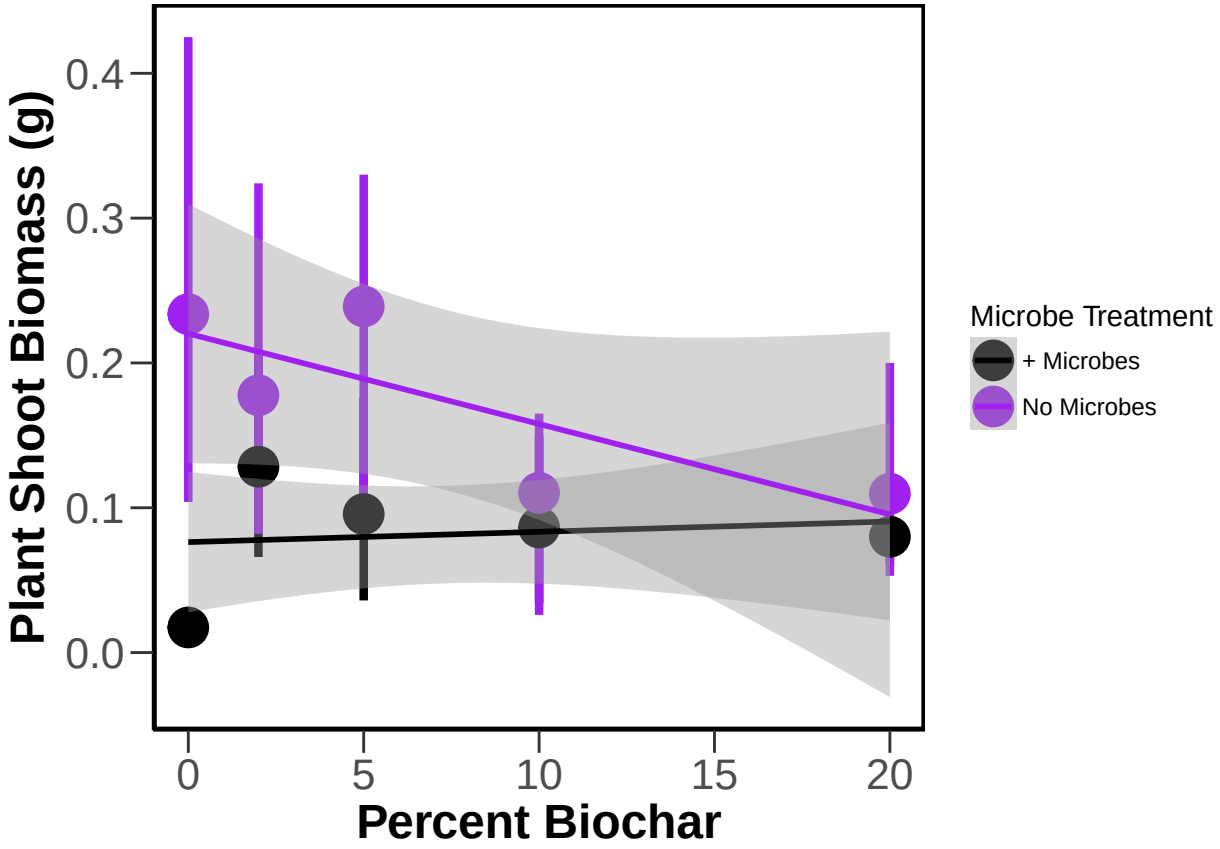
```
## Warning: Removed 30 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 30 rows containing non-finite values (stat_smooth).
```




```
p1 + theme_bw() + theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(), axis.li
```

```
## Warning: Removed 30 rows containing non-finite values (stat_summary).

## Warning: Removed 30 rows containing non-finite values (stat_smooth).
```




```
ggsave("../figures/Shoot.pdf", plot=last_plot(), device=NULL, path=NULL, scale=1, width=NA, height=NA, c

## Saving 6.5 x 4.5 in image

## Warning: Removed 30 rows containing non-finite values (stat_summary).

## Warning: Removed 30 rows containing non-finite values (stat_smooth).
```

Data Analysis - Root Biomass

```
data.lm <- lm(RootMass_g~Biochar*Microbe, data=data1)
anova(data.lm)

## Analysis of Variance Table
##
## Response: RootMass_g
##                  Df   Sum Sq   Mean Sq F value Pr(>F)
## Biochar           1 0.000709 0.0007091  0.1374 0.7138
## Microbe           1 0.005880 0.0058800  1.1397 0.2955
## Biochar:Microbe   1 0.002255 0.0022545  0.4370 0.5144
## Residuals        26 0.134143 0.0051593
```

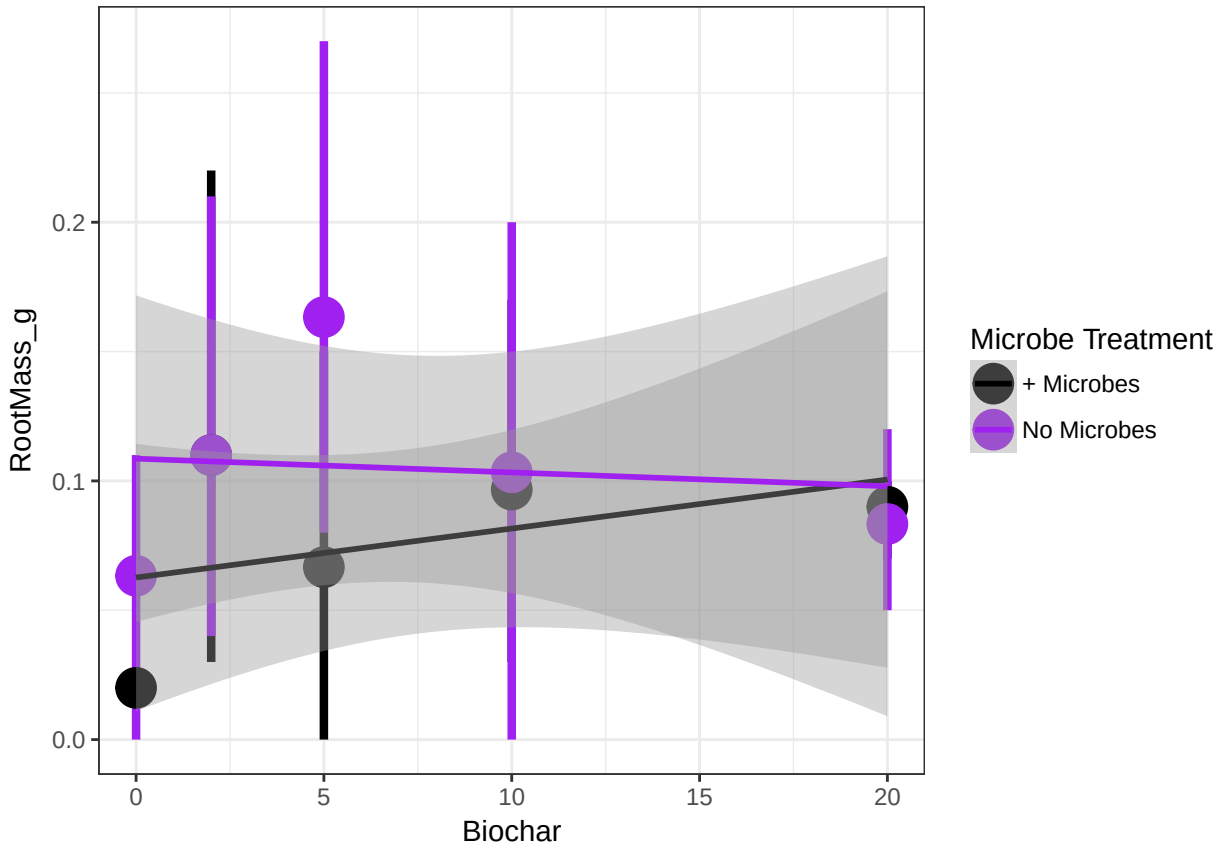
```r
summary(data.lm)
```

```
##
## Call:
## lm(formula = RootMass_g ~ Biochar * Microbe, data = data1)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.10861 -0.04265 -0.02004  0.01993  0.16405
##
## Coefficients:
##                             Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 0.062652   0.026702   2.346   0.0269 *
## Biochar                     0.001894   0.002596   0.730   0.4722
## MicrobeNoMicrobes           0.045959   0.037762   1.217   0.2345
## Biochar:MicrobeNoMicrobes -0.002427   0.003671  -0.661   0.5144
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.07183 on 26 degrees of freedom
##   (30 observations deleted due to missingness)
## Multiple R-squared:  0.06185,    Adjusted R-squared:  -0.0464
## F-statistic: 0.5714 on 3 and 26 DF,  p-value: 0.6389
```

```r
#graphing root biomass microbes x biochar
p <- ggplot(data1, aes(x=Biochar, y=RootMass_g, color=as.factor(Microbe)))+ scale_color_manual(name="Mi
p1=p+geom_smooth(method="lm")
p1 + theme_bw()
```

```
## Warning: Removed 30 rows containing non-finite values (stat_summary).
```

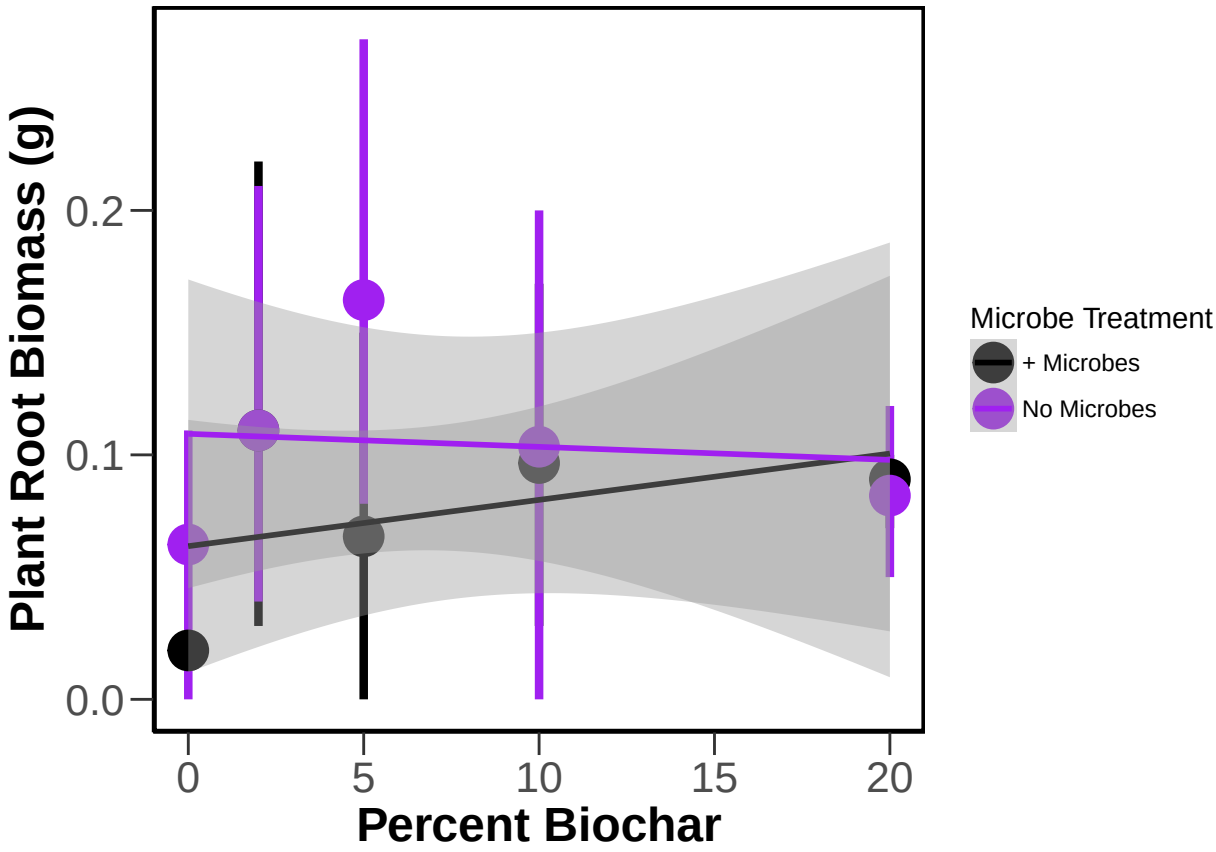
```
## Warning: Removed 30 rows containing non-finite values (stat_smooth).
```




```
p1 + theme_bw() + theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(), axis.li
```

```
## Warning: Removed 30 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 30 rows containing non-finite values (stat_smooth).
```




```
ggsave("../figures/Root.pdf", plot=last_plot(), device=NULL, path=NULL, scale=1, width=NA, height=NA, dp
```

```
## Saving 6.5 x 4.5 in image
```

```
## Warning: Removed 30 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 30 rows containing non-finite values (stat_smooth).
```

Data Analysis - testing moisture impact on plant biomass

```
#testing moisture impact on shoot biomass - MICROBES addition only
attach(data1)
newdata <- data1[ which(Microbe=='Microbes'),]
detach(data1)
data.lm <- lm(ShootMass_g~PercentMoisture, data=newdata)
summary(data.lm)
```

```
##
## Call:
## lm(formula = ShootMass_g ~ PercentMoisture, data = newdata)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.057649 -0.019197  0.007484  0.023140  0.061372
##
## Coefficients:
```

```
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)     0.0122631  0.0178344   0.688 0.503781
## PercentMoisture 0.0006039  0.0001308   4.615 0.000484 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.03731 on 13 degrees of freedom
##   (15 observations deleted due to missingness)
## Multiple R-squared:  0.621,  Adjusted R-squared:  0.5918
## F-statistic:  21.3 on 1 and 13 DF,  p-value: 0.0004841
```

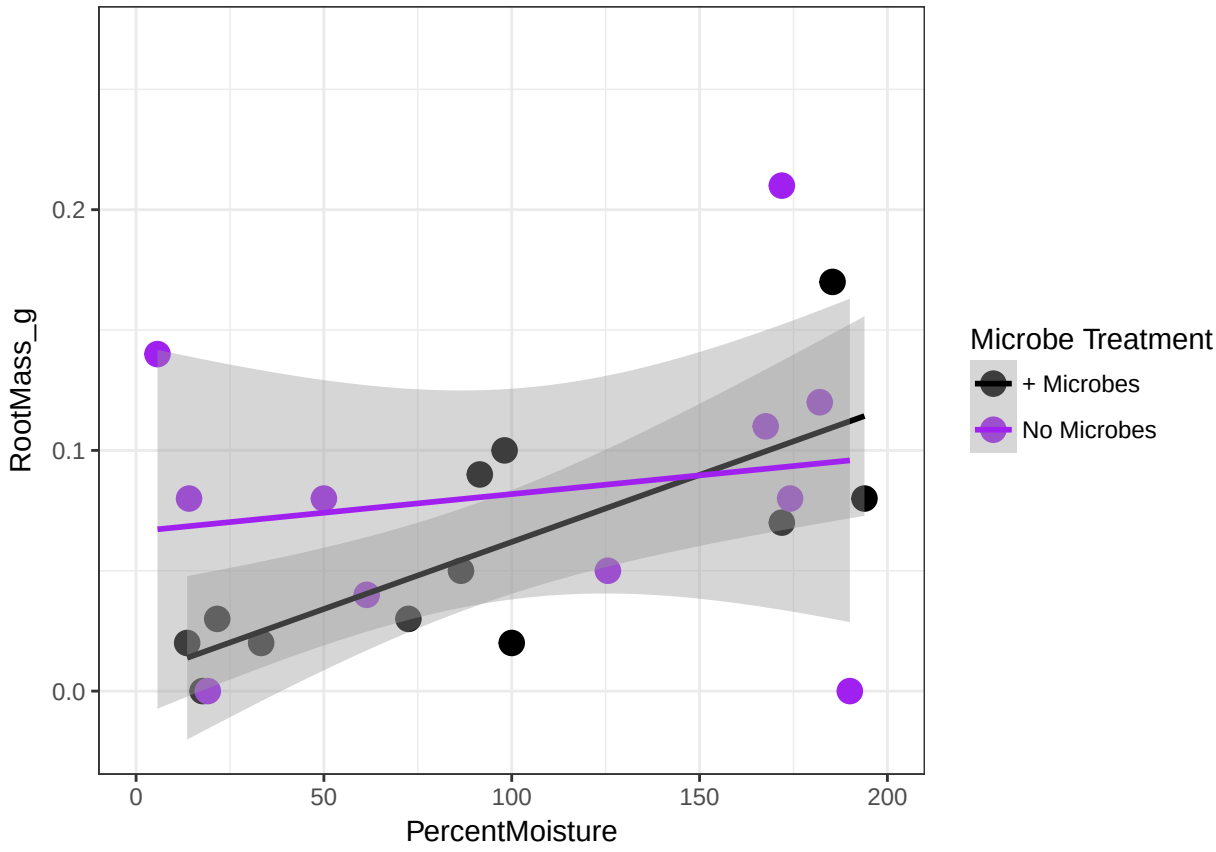
```
#testing moisture impact on shoot biomass - NO microbe addition only
attach(data1)
newdata2 <- data1[ which(Microbe=='NoMicrobes'),]
detach(data1)
data.lm2 <- lm(ShootMass_g~PercentMoisture, data=newdata2)
summary(data.lm2)
```

```
##
## Call:
## lm(formula = ShootMass_g ~ PercentMoisture, data = newdata2)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.15279 -0.06360 -0.04134  0.07873  0.22849
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)     0.1217974  0.0604919   2.013   0.0652 .
## PercentMoisture 0.0003932  0.0003942   0.997   0.3367
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.117 on 13 degrees of freedom
##   (15 observations deleted due to missingness)
## Multiple R-squared:  0.07109,    Adjusted R-squared:  -0.0003619
## F-statistic: 0.9949 on 1 and 13 DF,  p-value: 0.3367
```

```
#need to graph root biomass on y-axis and moisture on x-axis by microbe treatment
p <- ggplot(data1, aes(x=PercentMoisture, y=RootMass_g, color=Microbe))+ scale_color_manual(name="Microl
p1=p+geom_smooth(method="lm")
p1 + theme_bw() + xlim(0,200)
```

```
## Warning: Removed 37 rows containing non-finite values (stat_smooth).
```

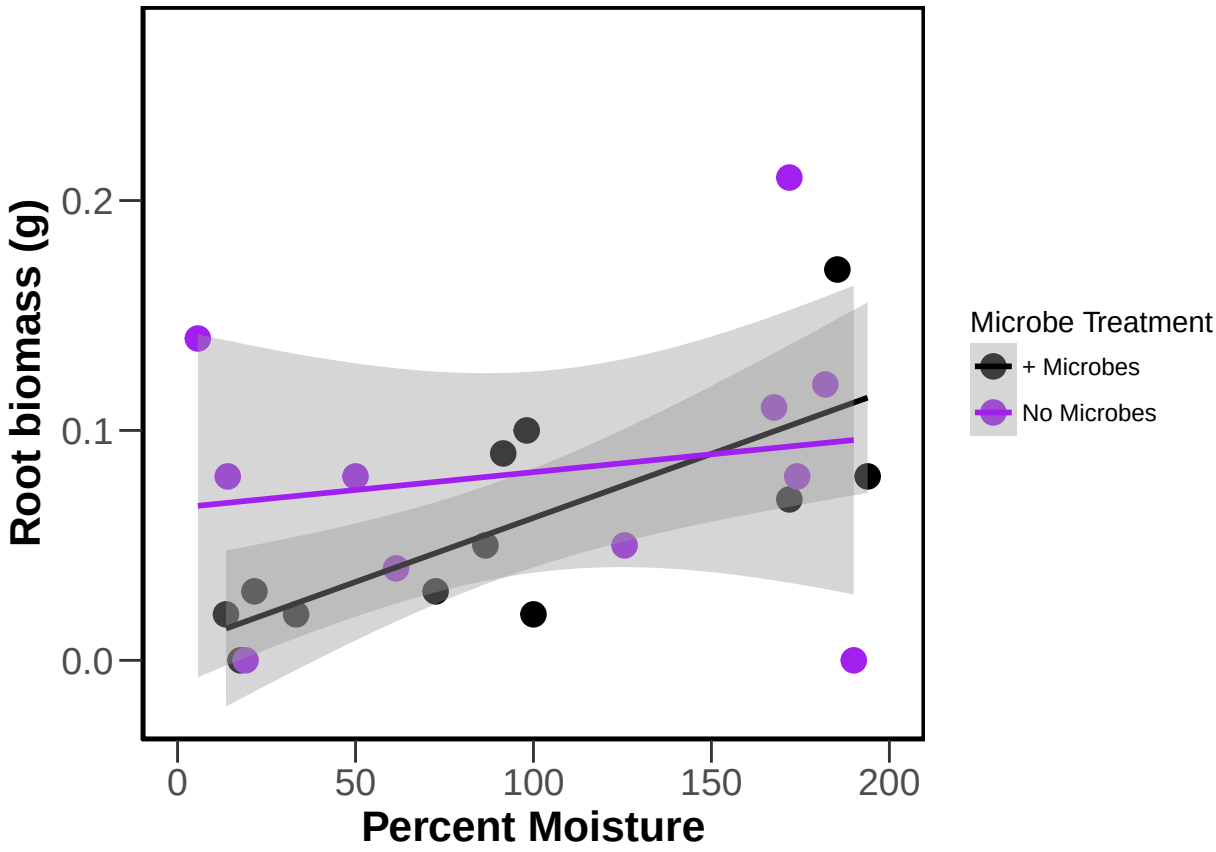
```
## Warning: Removed 37 rows containing missing values (geom_point).
```




```
p1 + theme_bw() + xlim(0,200) + theme(panel.grid.major = element_blank(), panel.grid.minor = element_bla
```

```
## Warning: Removed 37 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 37 rows containing missing values (geom_point).
```




```
ggsave("../figures/Moisture-Root.pdf", plot=last_plot(), device=NULL, path=NULL, scale=1, width=NA, hei
```

```
## Saving 6.5 x 4.5 in image
```

```
## Warning: Removed 37 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 37 rows containing missing values (geom_point).
```

Data Analysis - Soil C

```
data.lm <- lm(PercentC_Soil~Biochar*Microbe*Plant, data=data1)
anova(data.lm)
```

```
## Analysis of Variance Table
##
## Response: PercentC_Soil
##                       Df Sum Sq Mean Sq F value    Pr(>F)
## Biochar                1 2336.1 2336.11 24.3427 9.703e-06 ***
## Microbe                1   70.6   70.64  0.7361    0.3951
## Plant                  1  113.3  113.33  1.1809    0.2825
## Biochar:Microbe        1  220.4  220.43  2.2969    0.1361
## Biochar:Plant          1   75.3   75.28  0.7844    0.3801
## Microbe:Plant          1  244.6  244.56  2.5484    0.1168
## Biochar:Microbe:Plant  1   44.8   44.77  0.4665    0.4978
## Residuals             49 4702.4   95.97
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

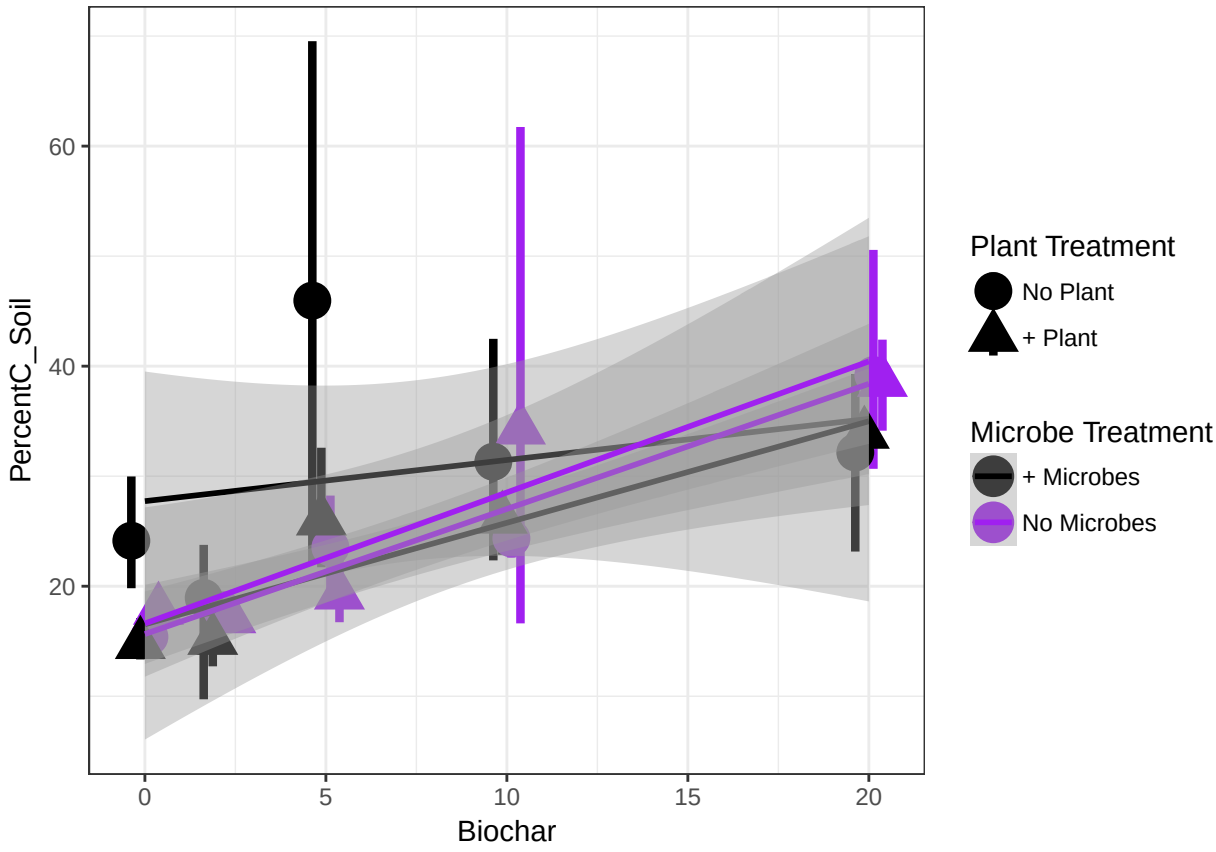
```
summary(data.lm)
```

```
##
## Call:
## lm(formula = PercentC_Soil ~ Biochar * Microbe * Plant, data = data1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -18.756  -4.423  -1.282   1.462  39.935
##
## Coefficients:
##                                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)                         27.7311     3.6417   7.615 7.45e-10
## Biochar                              0.3740     0.3540   1.056   0.2959
## MicrobeNoMicrobes                  -12.0797     5.1501  -2.346   0.0231
## PlantPlant                         -11.1960     5.2951  -2.114   0.0396
## Biochar:MicrobeNoMicrobes            0.7630     0.5007   1.524   0.1340
## Biochar:PlantPlant                   0.5488     0.5060   1.085   0.2834
## MicrobeNoMicrobes:PlantPlant        12.1556     7.6659   1.586   0.1192
## Biochar:MicrobeNoMicrobes:PlantPlant -0.4948     0.7244  -0.683   0.4978
##
## (Intercept)                        ***
## Biochar
## MicrobeNoMicrobes                  *
## PlantPlant                         *
## Biochar:MicrobeNoMicrobes
## Biochar:PlantPlant
## MicrobeNoMicrobes:PlantPlant
## Biochar:MicrobeNoMicrobes:PlantPlant
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 9.796 on 49 degrees of freedom
##   (3 observations deleted due to missingness)
## Multiple R-squared:  0.3977, Adjusted R-squared:  0.3117
## F-statistic: 4.622 on 7 and 49 DF,  p-value: 0.0004956
```

```
#graphing soil C microbes x biochar
p <- ggplot(data1, aes(x=Biochar, y=PercentC_Soil, color=as.factor(Microbe), shape=as.factor(Plant))) +
p1=p+geom_smooth(method="lm")
p1 + theme_bw()
```

```
## Warning: Removed 3 rows containing non-finite values (stat_summary).
```

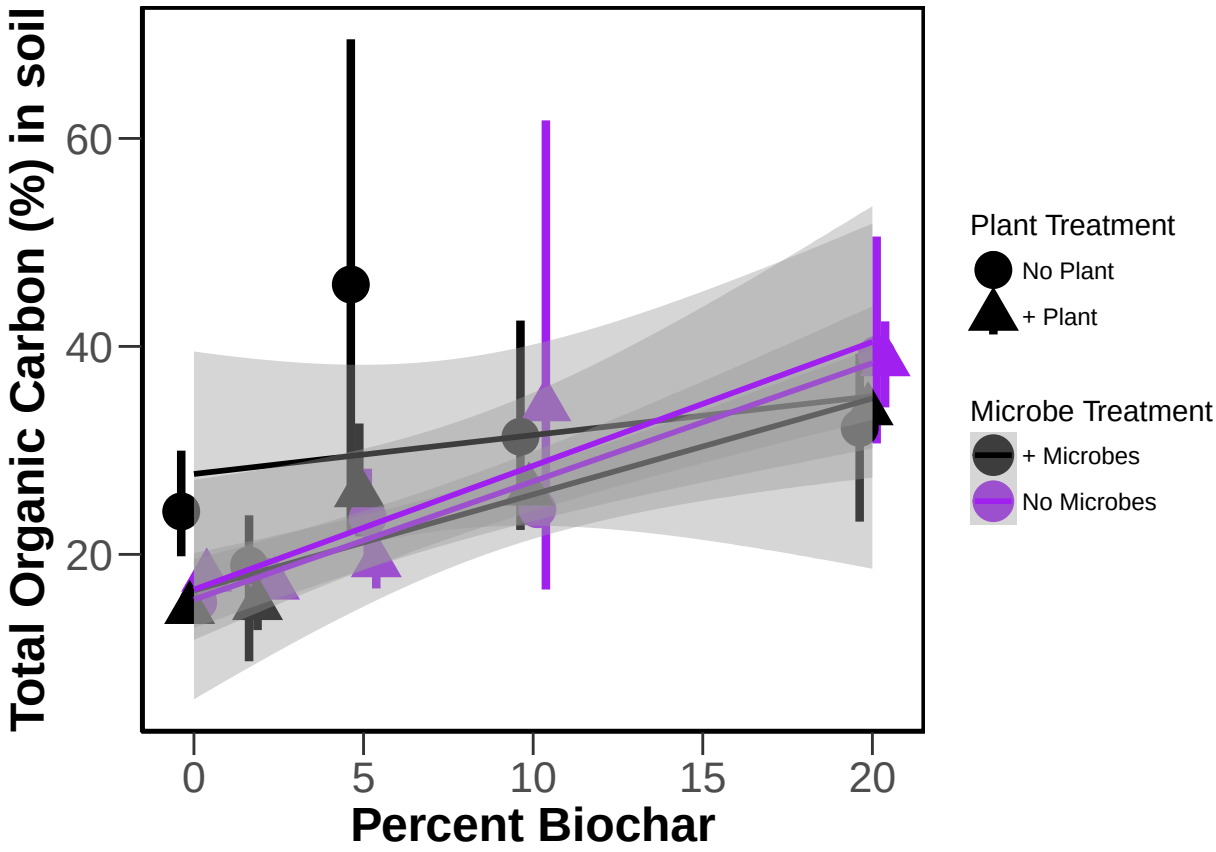
```
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
```




```
p1 + theme_bw() + theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(), axis.li
```

```
## Warning: Removed 3 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
```




```
ggsave("../figures/SoilC.pdf", plot=last_plot(), device=NULL, path=NULL, scale=1, width=NA, height=NA, c
```

```
## Saving 6.5 x 4.5 in image
```

```
## Warning: Removed 3 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
```

Data Analysis - Soil N

```
data.lm <- lm(PercentN_Soil~Biochar*Microbe*Plant, data=data1)
anova(data.lm)
```

```
## Analysis of Variance Table
##
## Response: PercentN_Soil
##                       Df Sum Sq Mean Sq F value    Pr(>F)
## Biochar                1 7.4699  7.4699 59.1500 5.689e-10 ***
## Microbe                1 0.0292  0.0292  0.2308    0.6331
## Plant                  1 0.0131  0.0131  0.1041    0.7484
## Biochar:Microbe        1 0.1816  0.1816  1.4376    0.2363
## Biochar:Plant          1 0.1955  0.1955  1.5479    0.2194
## Microbe:Plant          1 0.2321  0.2321  1.8375    0.1815
## Biochar:Microbe:Plant  1 0.0002  0.0002  0.0017    0.9677
## Residuals             49 6.1881  0.1263
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

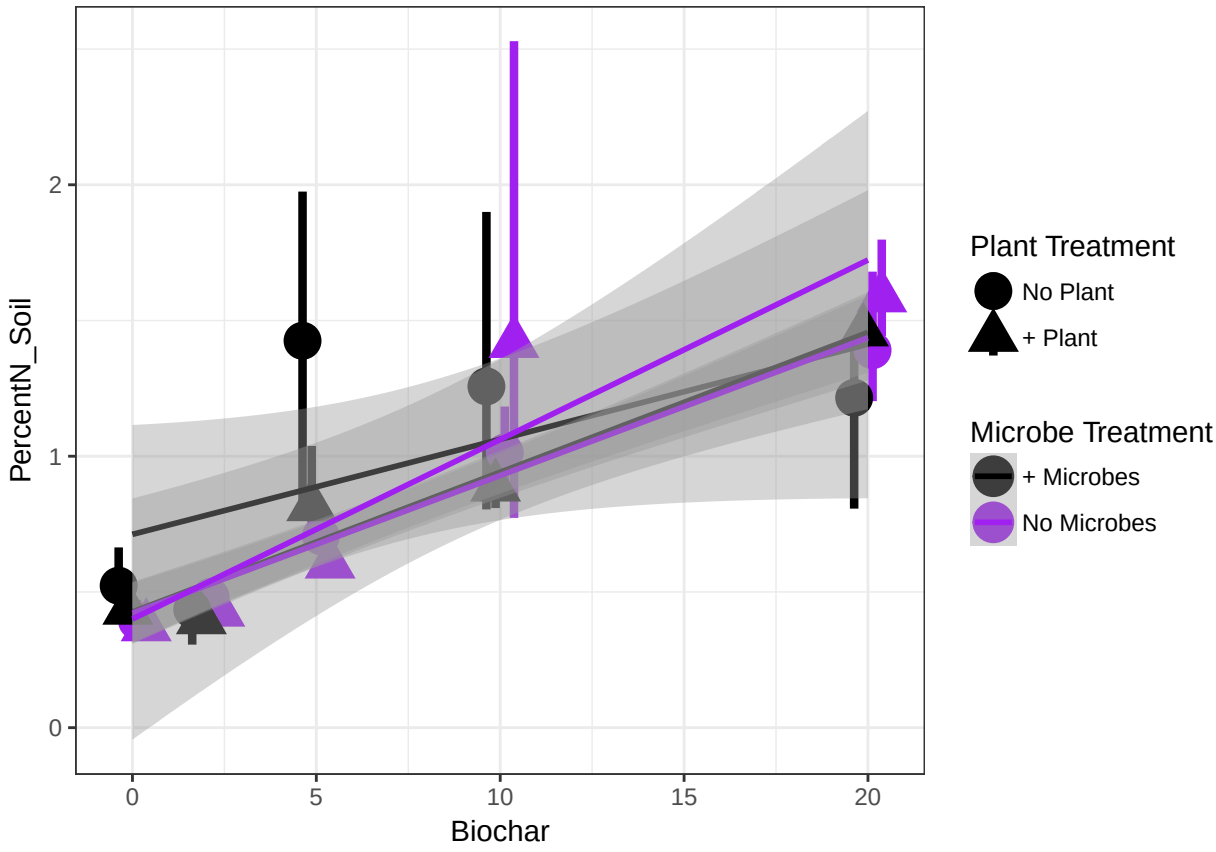
```
summary(data.lm)
```

```
##
## Call:
## lm(formula = PercentN_Soil ~ Biochar * Microbe * Plant, data = data1)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.60566 -0.13585 -0.04308  0.02052  1.46747
##
## Coefficients:
##                                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)                         0.71214    0.13211   5.391    2e-06
## Biochar                             0.03503    0.01284   2.727  0.00884
## MicrobeNoMicrobes                  -0.29070    0.18683  -1.556  0.12615
## PlantPlant                         -0.28566    0.19209  -1.487  0.14338
## Biochar:MicrobeNoMicrobes           0.01572    0.01816   0.866  0.39084
## Biochar:PlantPlant                  0.01645    0.01835   0.896  0.37441
## MicrobeNoMicrobes:PlantPlant        0.26440    0.27809   0.951  0.34639
## Biochar:MicrobeNoMicrobes:PlantPlant -0.00107    0.02628  -0.041  0.96769
##
## (Intercept)                        ***
## Biochar                            **
## MicrobeNoMicrobes
## PlantPlant
## Biochar:MicrobeNoMicrobes
## Biochar:PlantPlant
## MicrobeNoMicrobes:PlantPlant
## Biochar:MicrobeNoMicrobes:PlantPlant
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3554 on 49 degrees of freedom
##   (3 observations deleted due to missingness)
## Multiple R-squared:  0.5676, Adjusted R-squared:  0.5058
## F-statistic: 9.187 on 7 and 49 DF,  p-value: 3.34e-07
```

```
#graphing soil N microbes x biochar
p <- ggplot(data1, aes(x=Biochar, y=PercentN_Soil, color=as.factor(Microbe), shape=as.factor(Plant))) +
p1=p+geom_smooth(method="lm")
p1 + theme_bw()
```

```
## Warning: Removed 3 rows containing non-finite values (stat_summary).
```

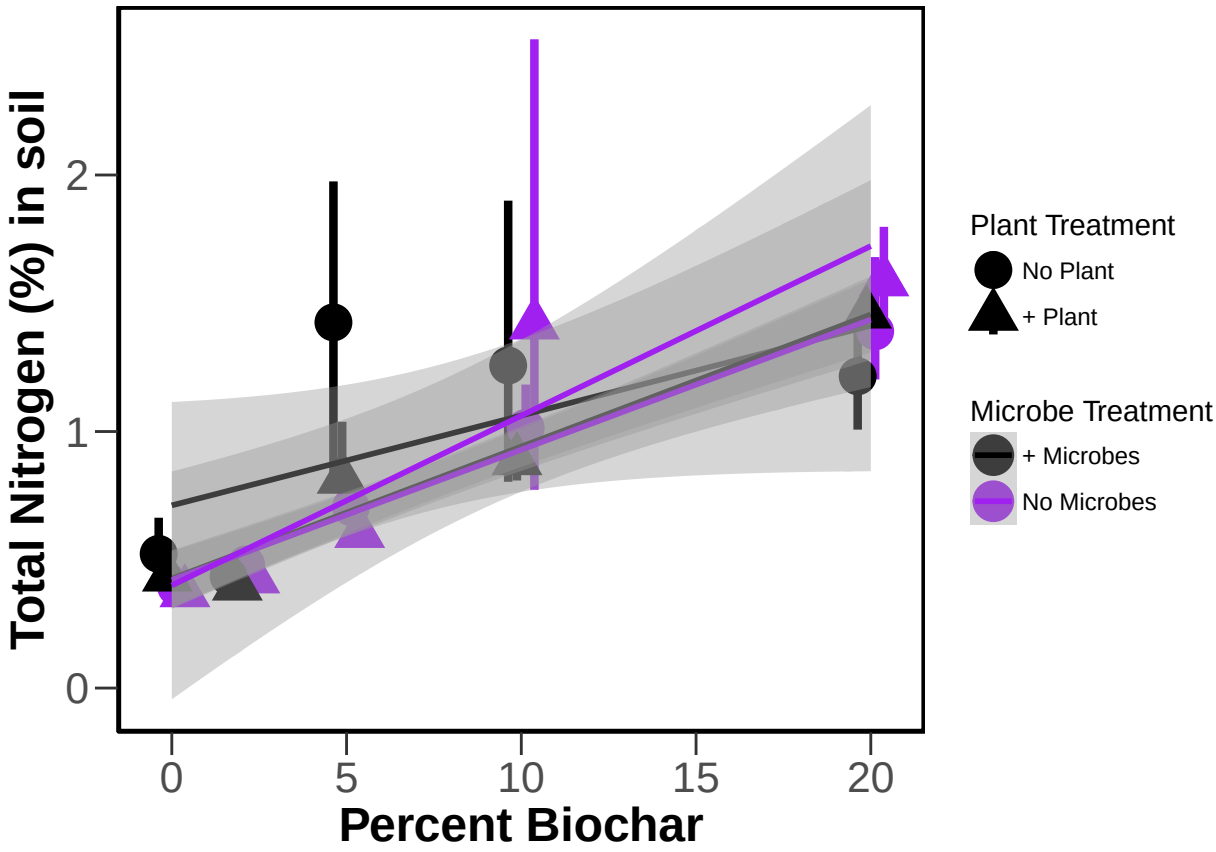
```
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
```




```
p1 + theme_bw() + theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(), axis.li
```

```
## Warning: Removed 3 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
```




```
ggsave("../figures/SoilN.pdf", plot=last_plot(), device=NULL, path=NULL, scale=1, width=NA, height=NA, c
```

```
## Saving 6.5 x 4.5 in image
```

```
## Warning: Removed 3 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
```

Data Analysis - Soil C:N ratio

```
data.lm <- lm(CNratio_Soil~Biochar*Microbe*Plant, data=data1)
anova(data.lm)
```

```
## Analysis of Variance Table
##
## Response: CNratio_Soil
##                       Df  Sum Sq Mean Sq F value    Pr(>F)
## Biochar                1 1872.29 1872.29 53.5879 2.119e-09 ***
## Microbe                1    0.63    0.63  0.0181    0.8935
## Plant                  1   30.86   30.86  0.8832    0.3519
## Biochar:Microbe        1    0.01    0.01  0.0004    0.9844
## Biochar:Plant          1    0.29    0.29  0.0084    0.9273
## Microbe:Plant          1   50.50   50.50  1.4455    0.2350
## Biochar:Microbe:Plant  1   97.28   97.28  2.7842    0.1016
## Residuals             49 1712.00   34.94
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

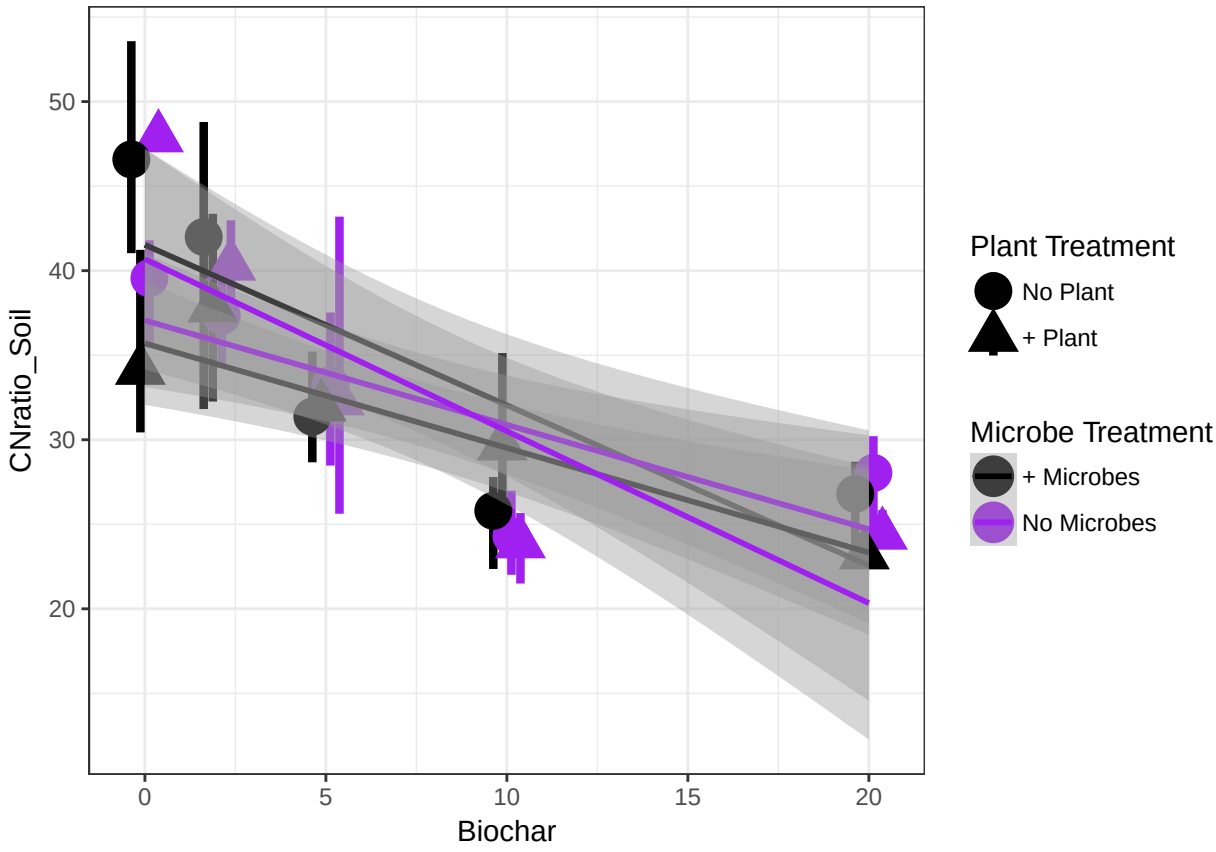
```
summary(data.lm)
```

```
##
## Call:
## lm(formula = CNratio_Soil ~ Biochar * Microbe * Plant, data = data1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -9.9667 -4.7941 -0.4907  4.7344 12.0473
##
## Coefficients:
##                                    Estimate Std. Error t value Pr(>|t|)
## (Intercept)                         41.5247     2.1973  18.898  < 2e-16
## Biochar                             -0.9484     0.2136  -4.439 5.13e-05
## MicrobeNoMicrobes                   -4.4661     3.1075  -1.437   0.1570
## PlantPlant                          -5.8244     3.1950  -1.823   0.0744
## Biochar:MicrobeNoMicrobes            0.3309     0.3021   1.095   0.2787
## Biochar:PlantPlant                   0.3298     0.3053   1.080   0.2853
## MicrobeNoMicrobes:PlantPlant         9.4415     4.6255   2.041   0.0466
## Biochar:MicrobeNoMicrobes:PlantPlant -0.7294     0.4371  -1.669   0.1016
##
## (Intercept)                         ***
## Biochar                             ***
## MicrobeNoMicrobes
## PlantPlant                          .
## Biochar:MicrobeNoMicrobes
## Biochar:PlantPlant
## MicrobeNoMicrobes:PlantPlant        *
## Biochar:MicrobeNoMicrobes:PlantPlant
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.911 on 49 degrees of freedom
##   (3 observations deleted due to missingness)
## Multiple R-squared:  0.5451, Adjusted R-squared:  0.4802
## F-statistic:  8.39 on 7 and 49 DF,  p-value: 1.049e-06
```

```
#graphing soil C:N ratio microbes x biochar
p <- ggplot(data1, aes(x=Biochar, y=CNratio_Soil, color=as.factor(Microbe), shape=as.factor(Plant))) + s
p1=p+geom_smooth(method="lm")
p1 + theme_bw()
```

```
## Warning: Removed 3 rows containing non-finite values (stat_summary).
```

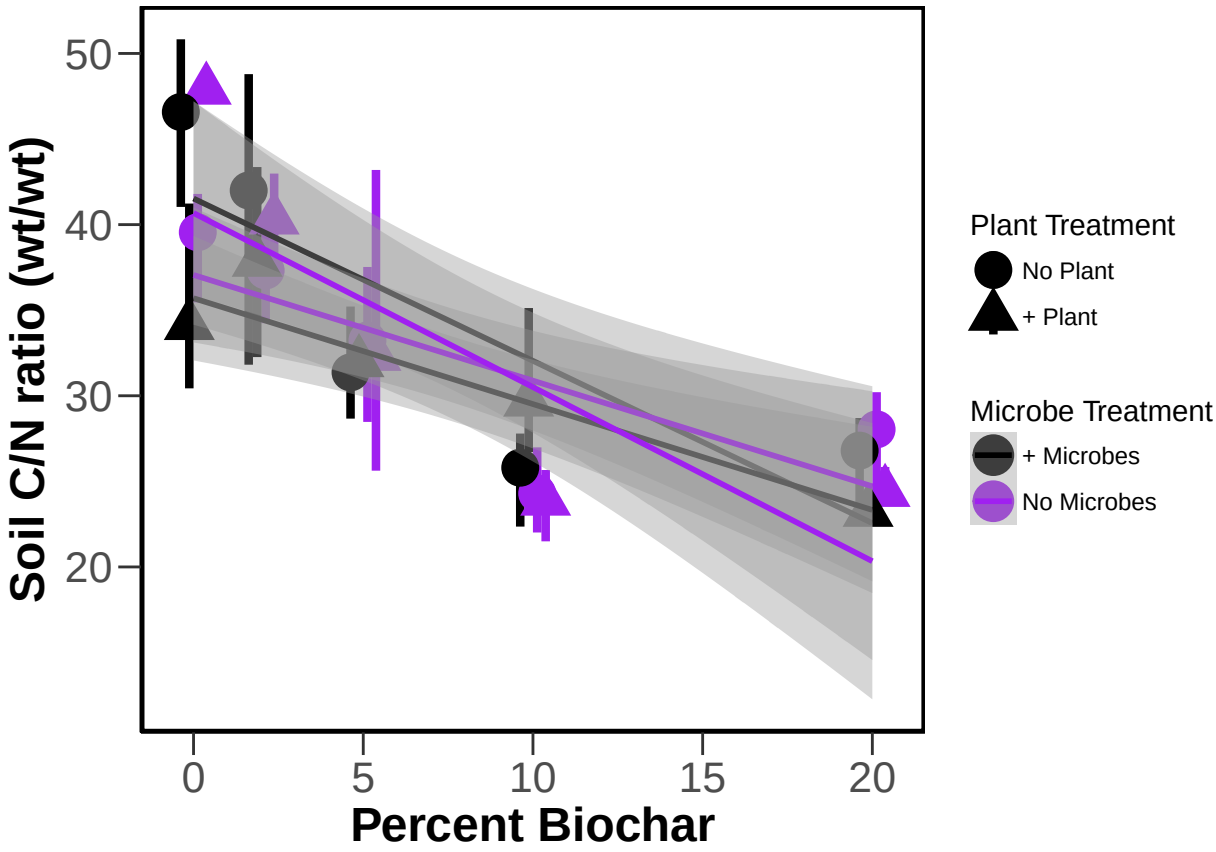
```
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
```




```
p1 + theme_bw() + theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(), axis.li
```

```
## Warning: Removed 3 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
```




```
ggsave("../figures/SoilCNratio.pdf", plot=last_plot(), device=NULL, path=NULL, scale=1, width=NA, heigh
```

```
## Saving 6.5 x 4.5 in image
```

```
## Warning: Removed 3 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
```

Data Analysis - Soil delta13C

```
data.lm <- lm(X13C_Soil~Biochar*Microbe*Plant, data=data1)
anova(data.lm)
```

```
## Analysis of Variance Table
##
## Response: X13C_Soil
##                       Df Sum Sq Mean Sq  F value Pr(>F)
## Biochar                1 471.06  471.06 154.4293 <2e-16 ***
## Microbe                1   4.25    4.25   1.3918 0.2438
## Plant                  1   2.31    2.31   0.7569 0.3885
## Biochar:Microbe        1   0.14    0.14   0.0452 0.8326
## Biochar:Plant          1   4.16    4.16   1.3652 0.2483
## Microbe:Plant          1   0.73    0.73   0.2385 0.6275
## Biochar:Microbe:Plant  1   2.14    2.14   0.7005 0.4067
## Residuals             49 149.47    3.05
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

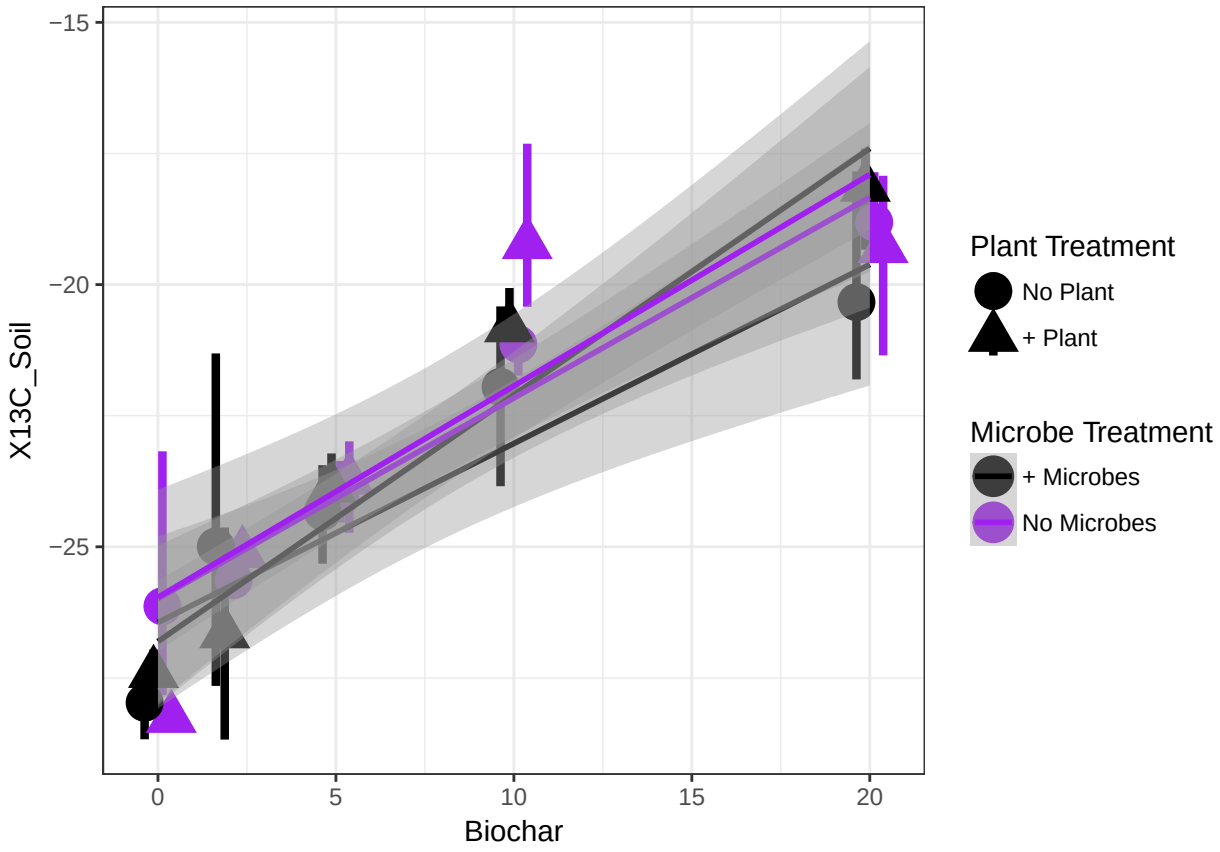
```
summary(data.lm)
```

```
##
## Call:
## lm(formula = X13C_Soil ~ Biochar * Microbe * Plant, data = data1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.4490 -0.8971 -0.2109  1.0208  4.6183
##
## Coefficients:
##                                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)                        -26.44195    0.64925 -40.727  < 2e-16
## Biochar                              0.34122    0.06312   5.406  1.9e-06
## MicrobeNoMicrobes                    0.45605    0.91818   0.497    0.622
## PlantPlant                          -0.36373    0.94403  -0.385    0.702
## Biochar:MicrobeNoMicrobes            0.04115    0.08927   0.461    0.647
## Biochar:PlantPlant                   0.12887    0.09021   1.429    0.159
## MicrobeNoMicrobes:PlantPlant         0.38595    1.36670   0.282    0.779
## Biochar:MicrobeNoMicrobes:PlantPlant -0.10810    0.12916  -0.837    0.407
##
## (Intercept)                         ***
## Biochar                             ***
## MicrobeNoMicrobes
## PlantPlant
## Biochar:MicrobeNoMicrobes
## Biochar:PlantPlant
## MicrobeNoMicrobes:PlantPlant
## Biochar:MicrobeNoMicrobes:PlantPlant
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.747 on 49 degrees of freedom
##   (3 observations deleted due to missingness)
## Multiple R-squared:  0.7643, Adjusted R-squared:  0.7307
## F-statistic:  22.7 on 7 and 49 DF,  p-value: 2.335e-13
```

```
#graphing soil delta 13C microbes x biochar
p <- ggplot(data1, aes(x=Biochar, y=X13C_Soil, color=as.factor(Microbe), shape=as.factor(Plant))) + scal
p1=p+geom_smooth(method="lm")
p1 + theme_bw()
```

```
## Warning: Removed 3 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
```




```
p1 + theme_bw() + theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(), axis.li
```

```
## Warning: Removed 3 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): font
## metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for <e2>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for <80>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>
```

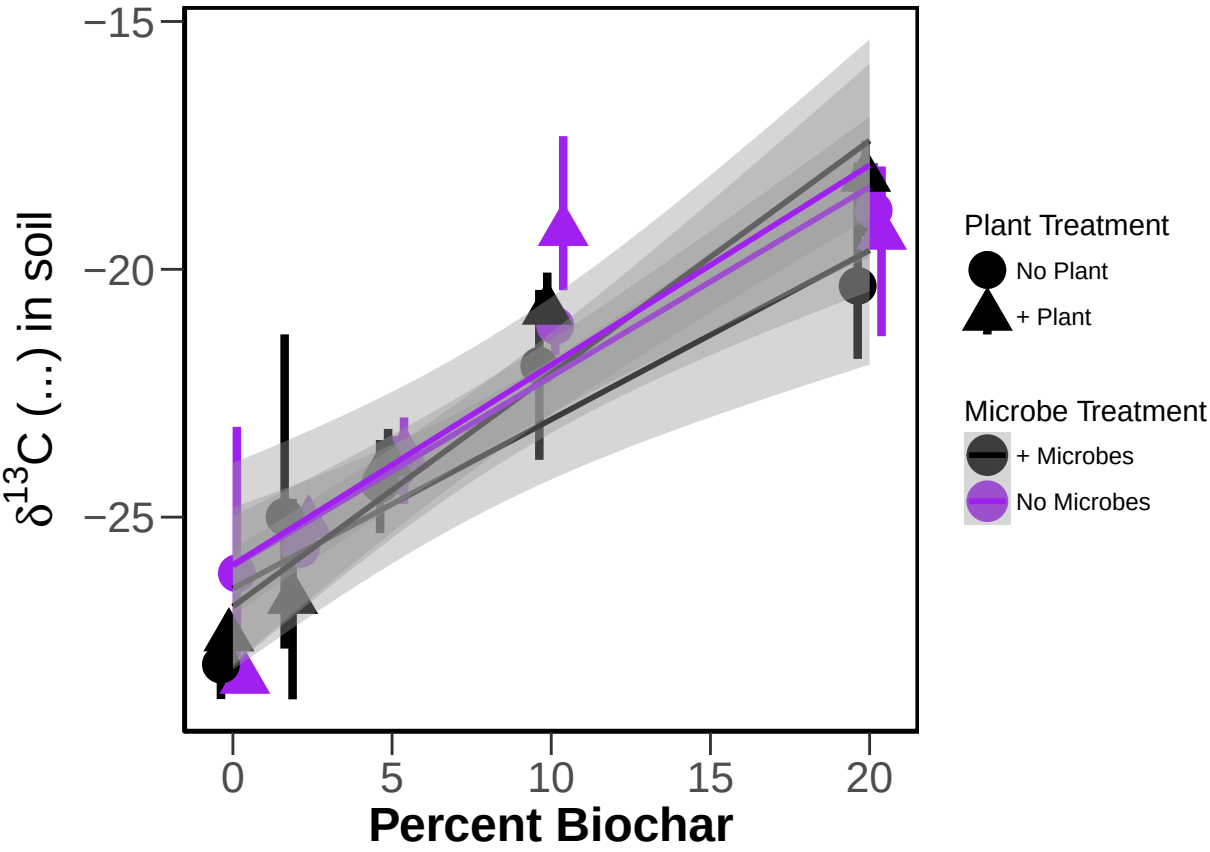
```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
```

```
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
```

```
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <b0>
```




```
ggsave("../figures/Soil_13C.pdf", plot=last_plot(), device=NULL, path=NULL, scale=1, width=NA, height=NA
```

```
## Saving 6.5 x 4.5 in image
## Warning: Removed 3 rows containing non-finite values (stat_summary).
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): font
## metrics unknown for Unicode character U+2030
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for <e2>
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for <80>
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for <b0>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
```

```
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

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## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

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## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## font metrics unknown for Unicode character U+2030

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## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## <80>

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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in soil' in 'mbcsToSbcs': dot substituted for
```

```
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in soil' in 'mbcsToSbcs': dot
```

```
## substituted for <b0>
```

Data Analysis - Soil delta15N

```
data.lm <- lm(X15N_Soil~Biochar*Microbe, data=data1)
anova(data.lm)
```

```
## Analysis of Variance Table
##
## Response: X15N_Soil
##                 Df  Sum Sq Mean Sq F value    Pr(>F)
## Biochar          1  71.741  71.741 32.1595 6.014e-07 ***
## Microbe          1   0.784   0.784  0.3513    0.5559
## Biochar:Microbe  1   0.251   0.251  0.1123    0.7388
## Residuals       53 118.232   2.231
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

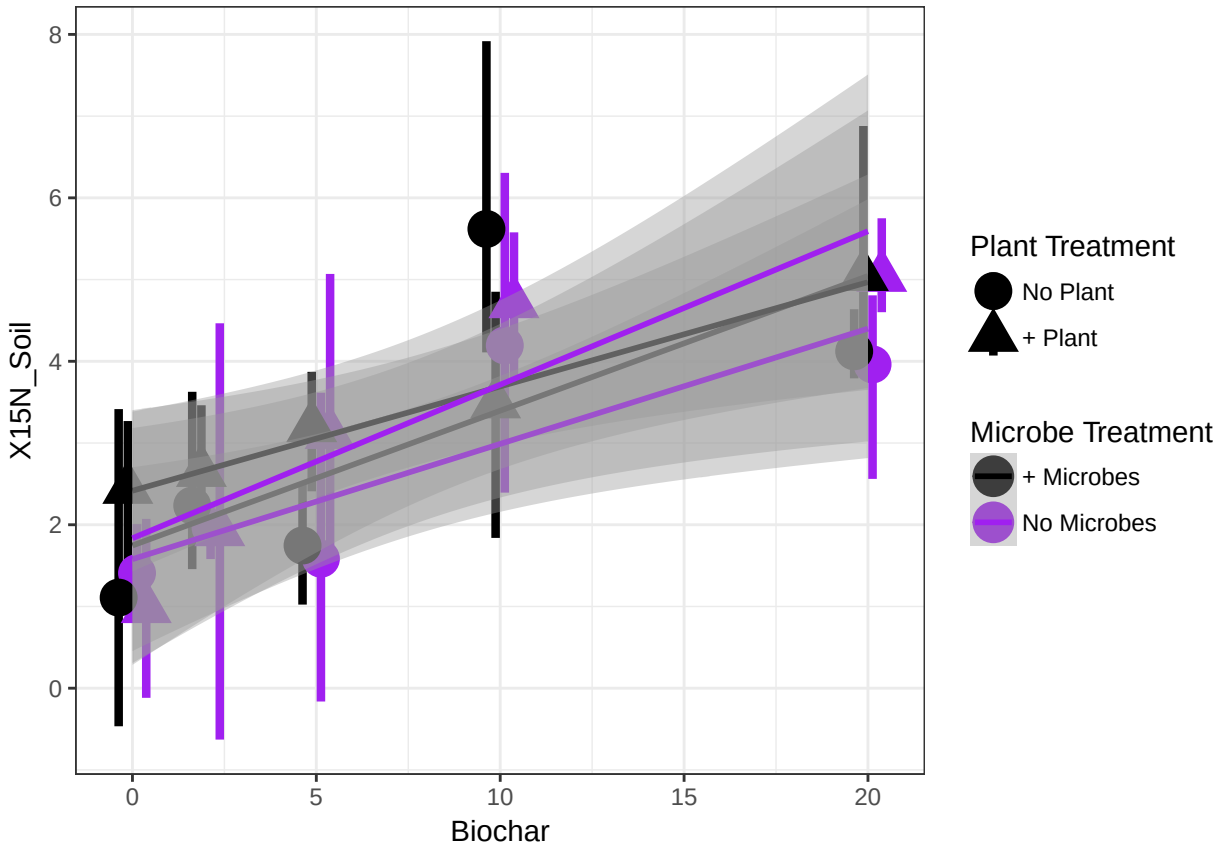
```
summary(data.lm)
```

```
##
## Call:
## lm(formula = X15N_Soil ~ Biochar * Microbe, data = data1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.6773 -0.9505 -0.2619  1.0718  4.3809
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 2.06227    0.40306   5.117  4.4e-06 ***
## Biochar                     0.14738    0.03855   3.823 0.000349 ***
## MicrobeNoMicrobes          -0.37717    0.58109  -0.649 0.519092
## Biochar:MicrobeNoMicrobes   0.01846    0.05508   0.335 0.738840
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.494 on 53 degrees of freedom
##   (3 observations deleted due to missingness)
## Multiple R-squared:  0.381,  Adjusted R-squared:  0.346
## F-statistic: 10.87 on 3 and 53 DF,  p-value: 1.129e-05
```

```
#graphing soil delta 15N microbes x biochar
p <- ggplot(data1, aes(x=Biochar, y=X15N_Soil, color=as.factor(Microbe), shape=as.factor(Plant))) + scal
p1=p+geom_smooth(method="lm")
p1 + theme_bw()
```

```
## Warning: Removed 3 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
```




```
p1 + theme_bw() + theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(), axis.li
```

```
## Warning: Removed 3 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): font
## metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for <e2>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for <80>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for
## <80>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for
```

```
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

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## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>
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```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
```

```
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <e2>

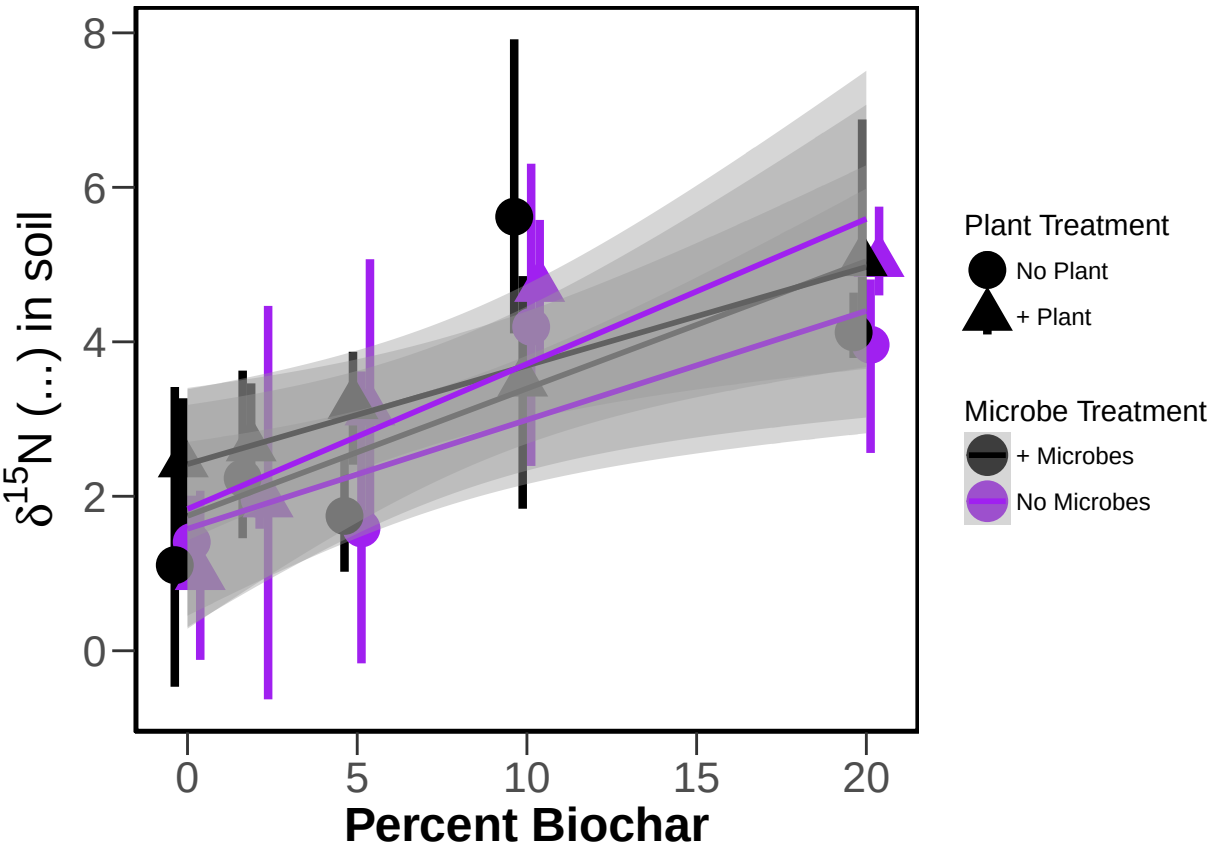
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <b0>
```




```
ggsave("../figures/Soil_15N.pdf", plot=last_plot(), device=NULL, path=NULL, scale=1, width=NA, height=NA
```

```
## Saving 6.5 x 4.5 in image
```

```
## Warning: Removed 3 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 3 rows containing non-finite values (stat_smooth).
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): font
## metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for <e2>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for <80>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for
## <80>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
```

```
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in soil' in 'mbcsToSbcs': dot substituted for
```

```
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in soil' in 'mbcsToSbcs': dot
```

```
## substituted for <b0>
```

Data Analysis - shoots delta13C

```
data.lm <- lm(X13C_Shoots~Biochar*Microbe, data=data1)
anova(data.lm)
```

```
## Analysis of Variance Table
##
## Response: X13C_Shoots
##                 Df Sum Sq Mean Sq F value  Pr(>F)
## Biochar          1 21.012  21.012  6.3906 0.01880 *
## Microbe          1 14.499  14.499  4.4097 0.04691 *
## Biochar:Microbe  1 11.952  11.952  3.6352 0.06914 .
## Residuals       23 75.623   3.288
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

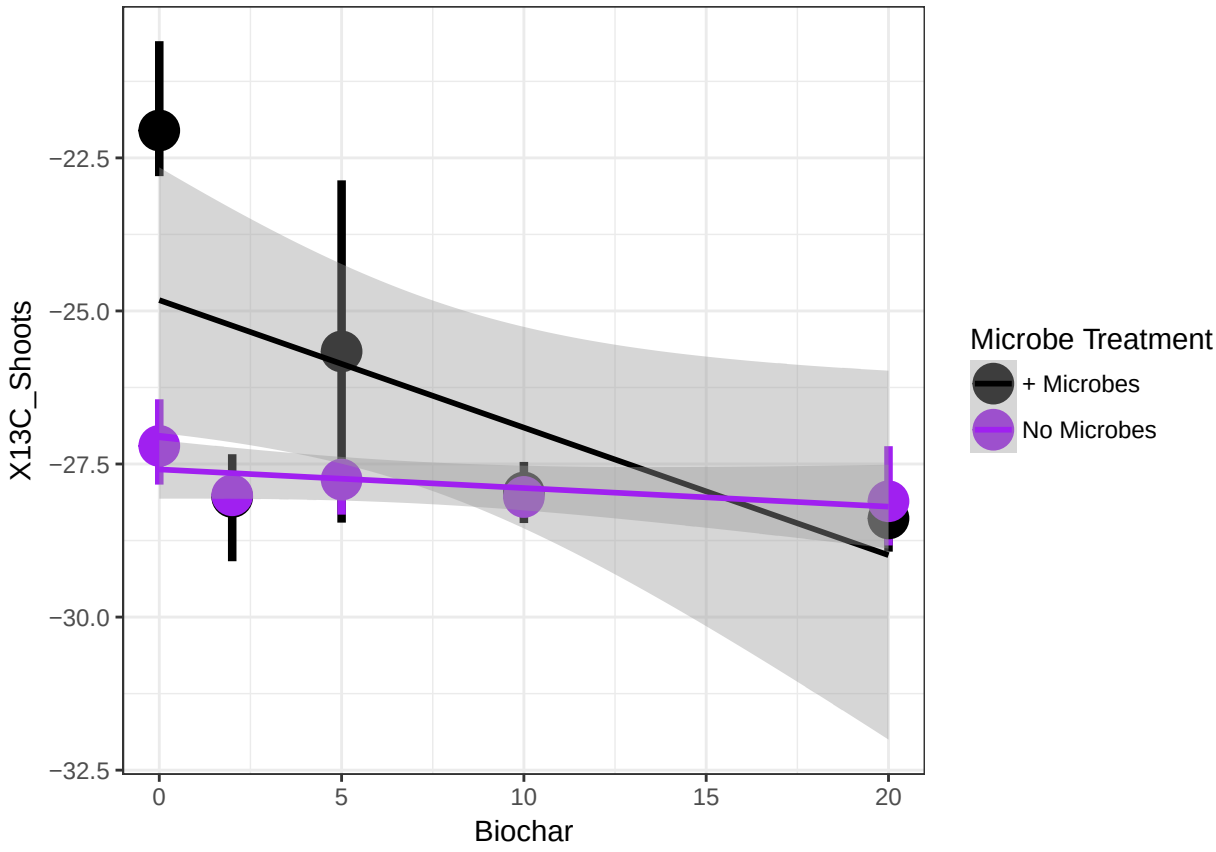
```
summary(data.lm)
```

```
##
## Call:
## lm(formula = X13C_Shoots ~ Biochar * Microbe, data = data1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.8483 -0.5735 -0.0540  0.8182  4.2292
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)               -24.82323    0.70072 -35.425  < 2e-16 ***
## Biochar                    -0.20825    0.06608  -3.152  0.00446 **
## MicrobeNoMicrobes          -2.76498    0.97546  -2.835  0.00939 **
## Biochar:MicrobeNoMicrobes   0.17785    0.09328   1.907  0.06914 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.813 on 23 degrees of freedom
##   (33 observations deleted due to missingness)
## Multiple R-squared:  0.3856, Adjusted R-squared:  0.3055
## F-statistic: 4.812 on 3 and 23 DF,  p-value: 0.0096
```

```
#graphing shoots delta 13C microbes x biochar
p <- ggplot(data1, aes(x=Biochar, y=X13C_Shoots, color=as.factor(Microbe)))+ scale_color_manual(name="M
p1=p+geom_smooth(method="lm")
p1 + theme_bw()
```

```
## Warning: Removed 33 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 33 rows containing non-finite values (stat_smooth).
```




```
p1 + theme_bw() + theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(), axis.li
```

```
## Warning: Removed 33 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 33 rows containing non-finite values (stat_smooth).
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): font
## metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted for <e2>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted for <80>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted for <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <e2>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
```

```
## for <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>
```

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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## font metrics unknown for Unicode character U+2030
```

```
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## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
```
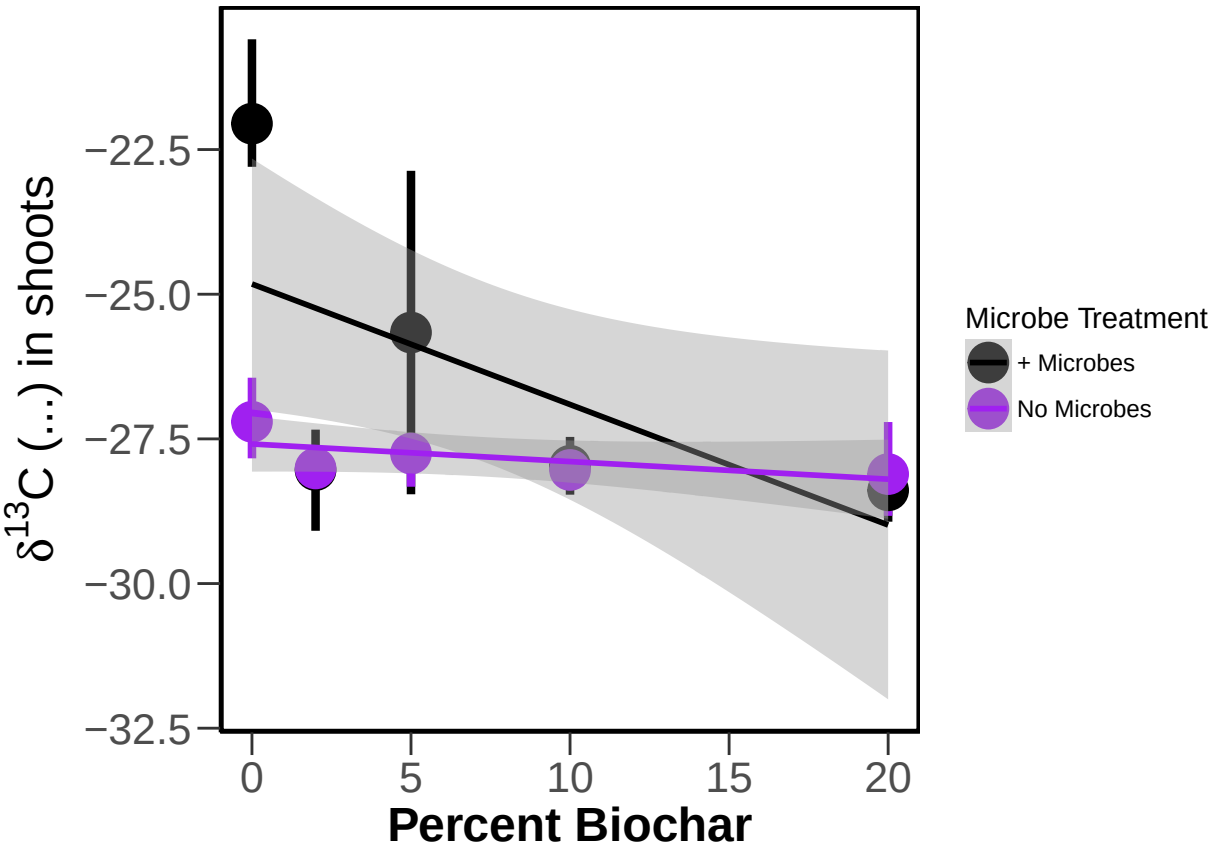

```
## for <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <b0>
```




```
ggsave("../figures/shoots_13C.pdf", plot=last_plot(), device=NULL, path=NULL, scale=1, width=NA, height=
```

```
## Saving 6.5 x 4.5 in image
```

```
## Warning: Removed 33 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 33 rows containing non-finite values (stat_smooth).
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): font
## metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (%) in shoots' in 'mbcsToSbcs': dot substituted for <e2>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (%) in shoots' in 'mbcsToSbcs': dot substituted for <80>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (%) in shoots' in 'mbcsToSbcs': dot substituted for <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot substituted
## for <e2>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
```

```
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>
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```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## for <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in shoots' in 'mbcsToSbcs': dot substituted
```

```
## for <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
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## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in shoots' in 'mbcsToSbcs': dot
```

```
## substituted for <b0>
```

Data Analysis - shoots delta15N

```
data.lm <- lm(X15N_Shoots~Biochar*Microbe, data=data1)
anova(data.lm)
```

```
## Analysis of Variance Table
##
## Response: X15N_Shoots
##                 Df Sum Sq Mean Sq F value   Pr(>F)
## Biochar          1 47.365  47.365 21.1897 9.58e-05 ***
## Microbe          1  2.261   2.261  1.0113   0.3239
## Biochar:Microbe  1  0.078   0.078  0.0351   0.8529
## Residuals       26 58.118   2.235
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

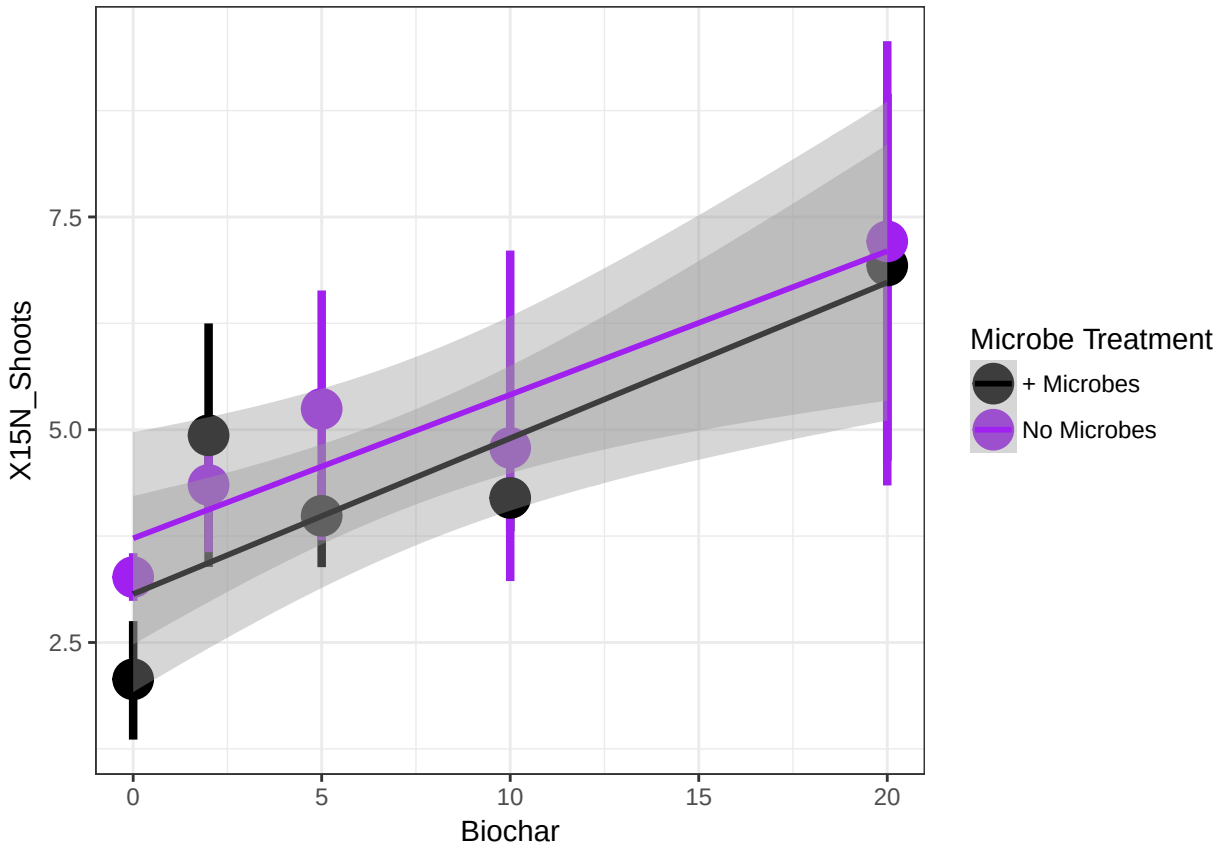
```
summary(data.lm)
```

```
##
## Call:
## lm(formula = X15N_Shoots ~ Biochar * Microbe, data = data1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -2.7534 -0.8336 -0.2465  0.7788  2.8139
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 3.06901    0.55579   5.522 8.52e-06 ***
## Biochar                     0.18303    0.05403   3.387  0.00226 **
## MicrobeNoMicrobes           0.65490    0.78600   0.833  0.41232
## Biochar:MicrobeNoMicrobes -0.01431    0.07642  -0.187  0.85290
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.495 on 26 degrees of freedom
##   (30 observations deleted due to missingness)
## Multiple R-squared:  0.461,  Adjusted R-squared:  0.3988
## F-statistic: 7.412 on 3 and 26 DF,  p-value: 0.0009582
```

```
#graphing shoots delta 15N microbes x biochar
p <- ggplot(data1, aes(x=Biochar, y=X15N_Shoots, color=as.factor(Microbe)))+ scale_color_manual(name="M
p1=p+geom_smooth(method="lm")
p1 + theme_bw()
```

```
## Warning: Removed 30 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 30 rows containing non-finite values (stat_smooth).
```




```
p1 + theme_bw() + theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(), axis.li
```

```
## Warning: Removed 30 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 30 rows containing non-finite values (stat_smooth).
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): font
## metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (%) in shoots' in 'mbcsToSbcs': dot substituted for <e2>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (%) in shoots' in 'mbcsToSbcs': dot substituted for <80>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (%) in shoots' in 'mbcsToSbcs': dot substituted for <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot substituted
## for <e2>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot substituted
```

```
## for <b0>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <e2>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <e2>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
```

```
## for <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>

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## conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
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## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
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## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
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## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
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## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
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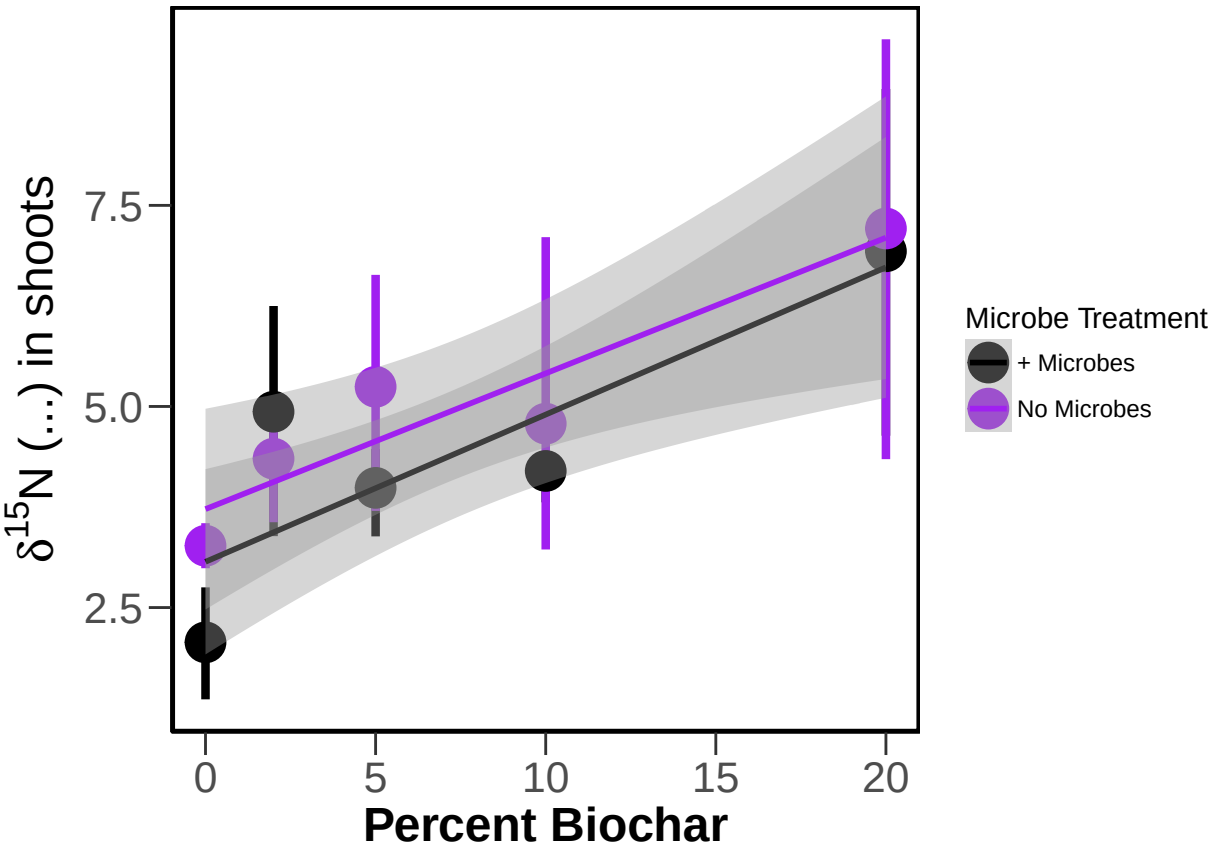
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <b0>
```




```
ggsave("../figures/shoots_15N.pdf", plot=last_plot(), device=NULL, path=NULL, scale=1, width=NA, height=
```

```
## Saving 6.5 x 4.5 in image
```

```
## Warning: Removed 30 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 30 rows containing non-finite values (stat_smooth).
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): font
## metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted for <e2>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted for <80>
```

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## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted for <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <e2>
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```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
```

```
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

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## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>

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## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
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```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in shoots' in 'mbcsToSbcs': dot substituted
```

```
## for <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot substituted
## for <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot substituted
## for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
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## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
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## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
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## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
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## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
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## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in shoots' in 'mbcsToSbcs': dot
```

```
## substituted for <b0>
```

Data Analysis - Roots delta13C

```
data.lm <- lm(X13C_Roots~Biochar*Microbe, data=data1)
anova(data.lm)
```

```
## Analysis of Variance Table
##
## Response: X13C_Roots
##                 Df  Sum Sq Mean Sq F value Pr(>F)
## Biochar          1    3.09   3.089  0.0394 0.8455
## Microbe          1    4.42   4.419  0.0564 0.8157
## Biochar:Microbe  1   99.27  99.269  1.2665 0.2793
## Residuals       14 1097.33  78.381
```

```
summary(data.lm)
```

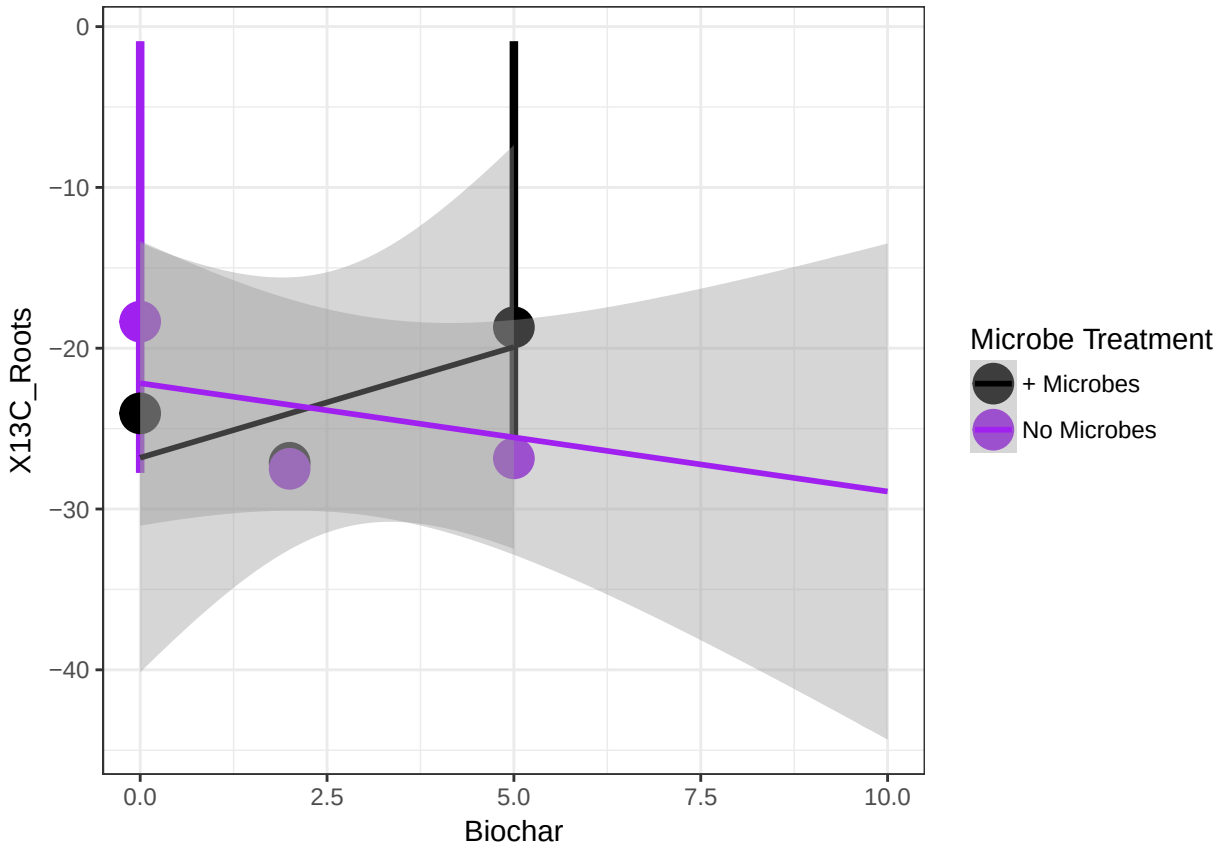
```
##
## Call:
## lm(formula = X13C_Roots ~ Biochar * Microbe, data = data1)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -7.746 -4.165 -2.975  1.569 21.271
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 -26.813      5.171  -5.185 0.000138 ***
## Biochar                       1.378      1.568   0.878 0.394502
## MicrobeNoMicrobes             4.635      6.547   0.708 0.490567
## Biochar:MicrobeNoMicrobes    -2.051      1.822  -1.125 0.279348
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.853 on 14 degrees of freedom
##   (42 observations deleted due to missingness)
## Multiple R-squared:  0.08868,    Adjusted R-squared:  -0.1066
## F-statistic: 0.4541 on 3 and 14 DF,  p-value: 0.7185
```

```
#graphing roots delta 13C microbes x biochar
p <- ggplot(data1, aes(x=Biochar, y=X13C_Roots, color=as.factor(Microbe)))+ scale_color_manual(name="Mi
p1=p+geom_smooth(method="lm")
p1 + theme_bw()
```

```
## Warning: Removed 42 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 42 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 1 rows containing missing values (geom_pointrange).
```




```
p1 + theme_bw() + theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(), axis.li
```

```
## Warning: Removed 42 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 42 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 1 rows containing missing values (geom_pointrange).
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): font
## metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (%) in roots' in 'mbcsToSbcs': dot substituted for <e2>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (%) in roots' in 'mbcsToSbcs': dot substituted for <80>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (%) in roots' in 'mbcsToSbcs': dot substituted for <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot substituted for
## <80>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
```

```
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
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## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
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## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
```

```
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
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## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
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## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <b0>
```
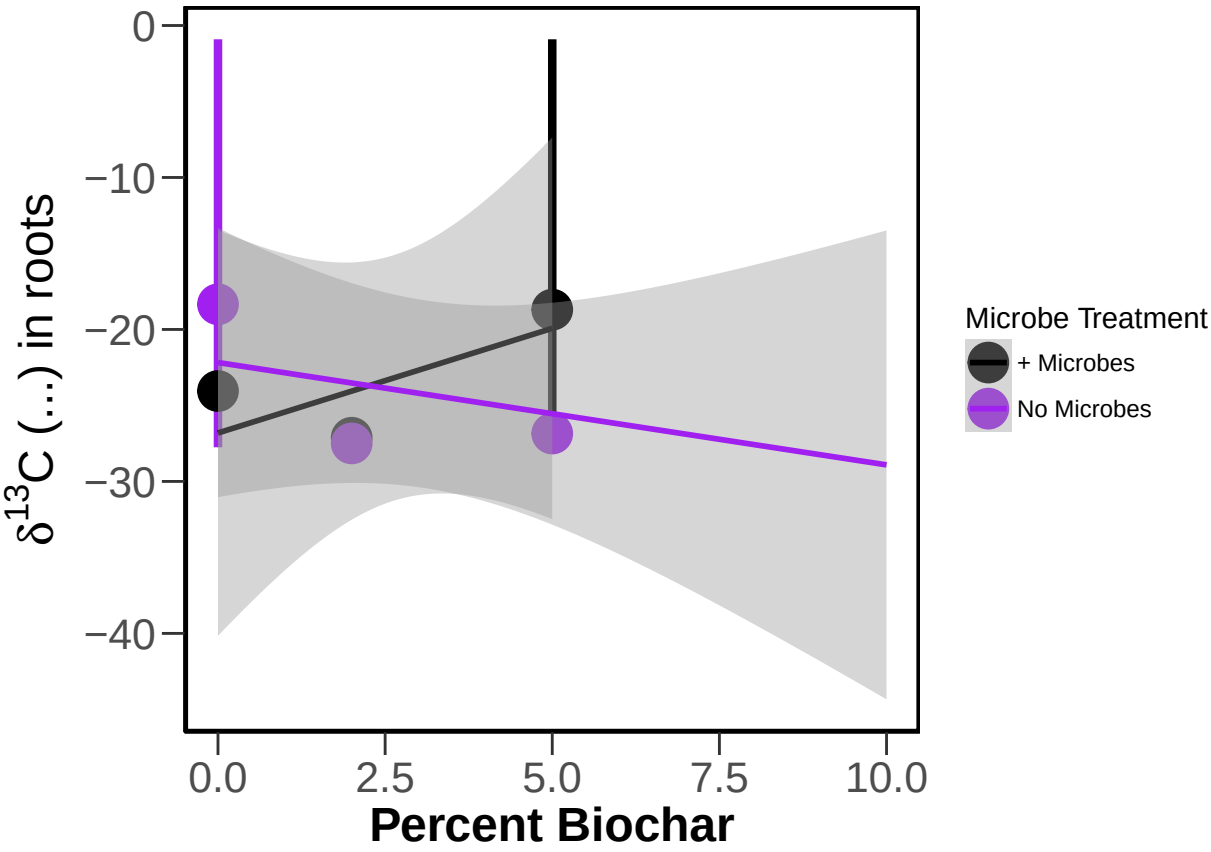




```
ggsave("../figures/Roots_13C.pdf", plot=last_plot(), device=NULL, path=NULL, scale=1, width=NA, height=
```

```
## Saving 6.5 x 4.5 in image
```

```
## Warning: Removed 42 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 42 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 1 rows containing missing values (geom_pointrange).
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): font
## metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for <e2>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for <80>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
```

```
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <80>
```

```
## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'C (%) in roots' in 'mbcsToSbcs': dot
## substituted for <b0>
```

Data Analysis - Roots delta15N

```
data.lm <- lm(X15N_Roots~Biochar*Microbe, data=data1)
anova(data.lm)
```

```
## Analysis of Variance Table
##
## Response: X15N_Roots
##                 Df  Sum Sq Mean Sq F value Pr(>F)
## Biochar          1   0.240  0.2405  0.0308 0.8630
## Microbe          1   3.390  3.3902  0.4342 0.5199
## Biochar:Microbe  1   8.288  8.2880  1.0614 0.3192
## Residuals       15 117.126  7.8084
```

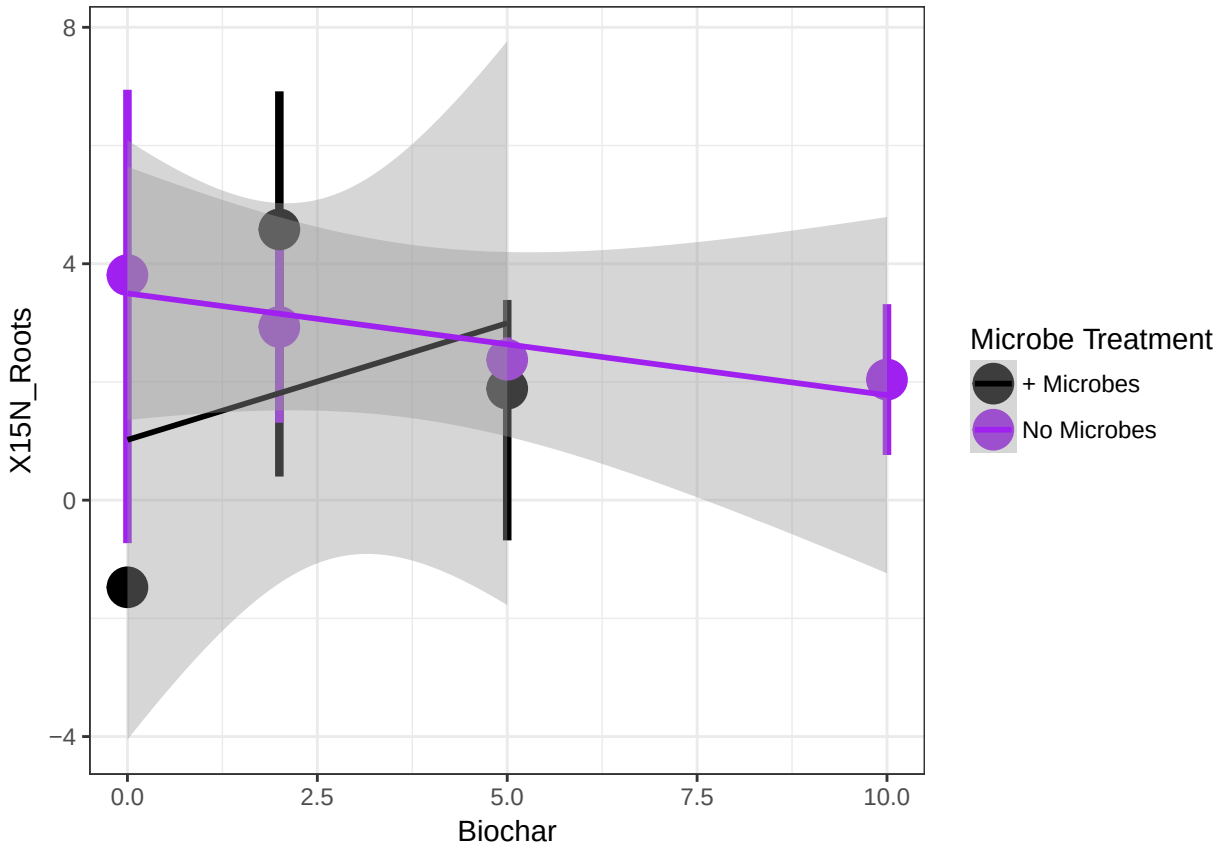
```
summary(data.lm)
```

```
##
## Call:
## lm(formula = X15N_Roots ~ Biochar * Microbe, data = data1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.2263 -1.6277 -0.1259  1.4193  5.1075
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  1.0193     1.6322   0.624    0.542
## Biochar                      0.3951     0.4949   0.798    0.437
## MicrobeNoMicrobes            2.4790     2.0451   1.212    0.244
## Biochar:MicrobeNoMicrobes   -0.5673     0.5506  -1.030    0.319
##
## Residual standard error: 2.794 on 15 degrees of freedom
##   (41 observations deleted due to missingness)
## Multiple R-squared:  0.09236,    Adjusted R-squared:  -0.08917
## F-statistic: 0.5088 on 3 and 15 DF,  p-value: 0.6822
```

```
#graphing roots delta 15N microbes x biochar
p <- ggplot(data1, aes(x=Biochar, y=X15N_Roots, color=as.factor(Microbe)))+ scale_color_manual(name="Mi
p1=p+geom_smooth(method="lm")
p1 + theme_bw()
```

```
## Warning: Removed 41 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 41 rows containing non-finite values (stat_smooth).
```




```
p1 + theme_bw() + theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(), axis.li
```

```
## Warning: Removed 41 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 41 rows containing non-finite values (stat_smooth).
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): font
## metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (%) in roots' in 'mbcsToSbcs': dot substituted for <e2>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (%) in roots' in 'mbcsToSbcs': dot substituted for <80>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (%) in roots' in 'mbcsToSbcs': dot substituted for <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot substituted for
## <80>
```

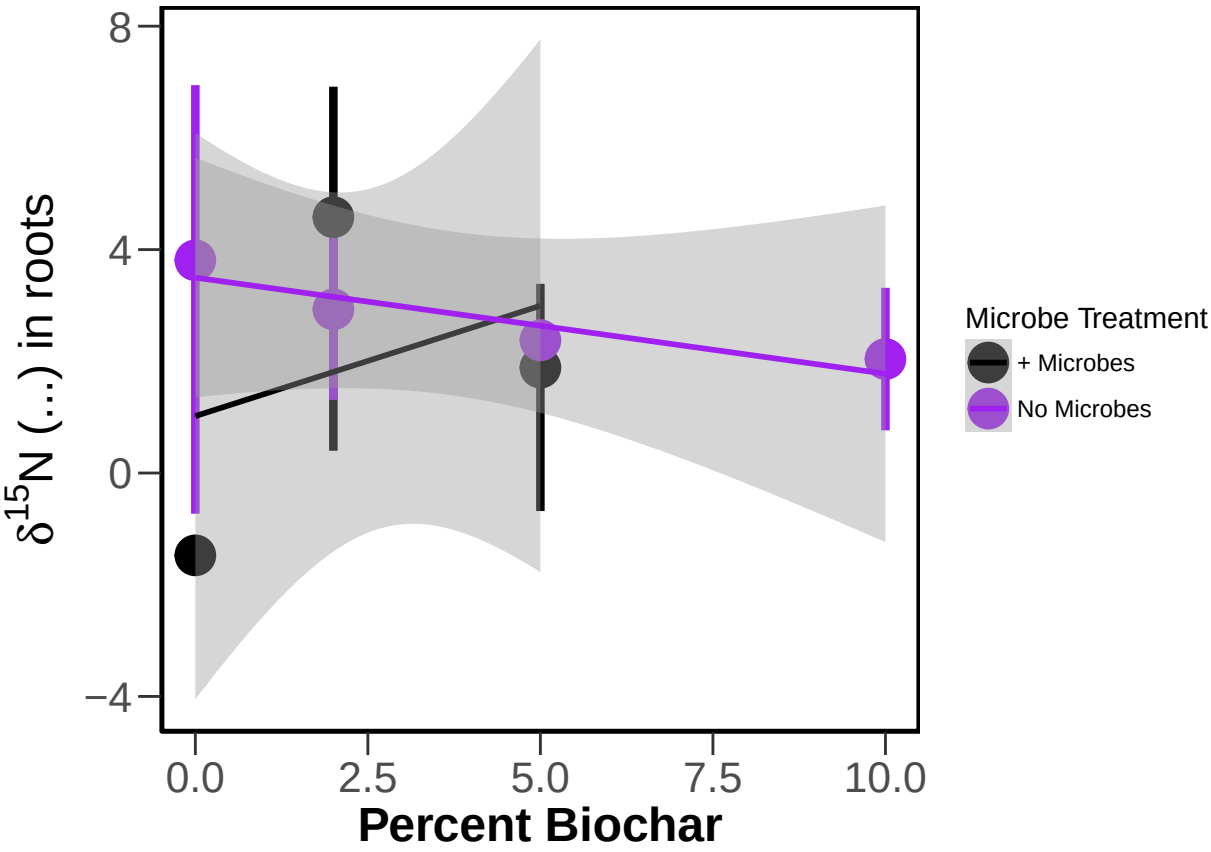
```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot substituted for
```

```
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
```

```
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <b0>
```




```
ggsave("../figures/Roots_15N.pdf", plot=last_plot(), device=NULL, path=NULL, scale=1, width=NA, height=
```

```
## Saving 6.5 x 4.5 in image
```

```
## Warning: Removed 41 rows containing non-finite values (stat_summary).
```

```
## Warning: Removed 41 rows containing non-finite values (stat_smooth).
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): font
## metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for <e2>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for <80>
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): conversion
## failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
```

```
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
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## <e2>

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## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## font metrics unknown for Unicode character U+2030

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (‰) in roots' in 'mbcsToSbcs': dot substituted for
```

```
## <e2>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot substituted for
## <80>

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, :
## conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot substituted for
## <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x$x, x
## $y, : font metrics unknown for Unicode character U+2030

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <b0>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <e2>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
## substituted for <80>

## Warning in grid.Call.graphics(C_text, as.graphicsAnnot(x$label), x
## $x, x$y, : conversion failure on 'N (%) in roots' in 'mbcsToSbcs': dot
```

```
## substituted for <b0>
```