2A & B: Pond Water Microbes

Caitlin Nordheim-Maestas

Data wrangling and analysis the AE microrganisms in pond water experiment using the SFEB (San Francisco East Bay) water samples for part A (nicknamed “fifteen sites” in our lab) and the follow up experiment part B with SBNCOS (Santa Barbara North Campus Open Space) pond water samples. These are the data presented in Figure 3A and 3B in the manuscript, and information is under the section “Experiment 2: Assessment of AE microorganisms’ inhibitory effects on Bd growth”.

# Load in data and libraries

## read in and clean data  
library(tidyverse) # for cleaning and viewing data  
library(gt) # pretty stats tables  
library(broom) # cleaning for gt  
library(here) # for importing data  
library(car) # stats tests like Levene's  
library(Hmisc) # autocalculate stat summaries in ggplot  
library(multcomp) # stats  
library(nlme) # mixed effects models  
library(emmeans) # for pairwise comparisons, especially on mixed effects models and glms  
library(ggpubr) # for making ggqq plot  
library(patchwork) # for combining figures  
library(multcompView) # for posthoc visualization  
  
# load "East Bay" experiment data  
fs\_pw\_bd <- read.csv(here("data", "fifteen-sites-PW-on-Bd - Sheet1.csv"))  
  
# load "SBNCOS" experiment data  
## note the data file is called 2b because it was initially the second figure but we added in a methods figure so this will be 3b  
sbncos\_raw <- read.csv(here("data", "final\_NCOS\_2024\_reformatted\_for\_R.xlsx - Fig2B.csv"))  
  
# Colors: these are from Paul Tol's colorblind friendly palette  
with\_microbes\_40\_color <- "#999933"  
no\_microbes\_.22\_color <- "#88ccee"  
  
# set up custom theme for figures (note figures may be redone in separate doc for journal specs)  
myCustomTheme <- function() {  
 theme\_light() +  
 theme(axis.text = element\_text(size = 12, family = "Times", color = "black"),  
 axis.title.x = element\_text(margin = margin(t = 10), size = 14, face = "bold", family = "Times", color = "black"), # Add space between x-axis label and axis  
 axis.title.y = element\_text(margin = margin(r = 10), size = 14, face = "bold", family = "Times", color = "black"), # Add space between y-axis label and axis  
 title = element\_text(size = 12, face = "bold", family = "Times"),  
 plot.caption = element\_text(size = 10, face = "italic", family = "Times"),  
 legend.text = element\_text(size = 10, family = "Times"), # Increase legend text size  
 panel.grid.major.x = element\_blank(), # Remove major vertical grid lines  
 panel.grid.minor.x = element\_blank(), # Remove minor vertical grid lines  
 panel.grid.major.y = element\_blank(), # Remove major horizontal grid lines  
 panel.grid.minor.y = element\_blank(), # Remove minor horizontal grid lines  
 strip.text = element\_text(size = 12, face = "bold", family = "Times", color = "black"), # Set strip text style  
 strip.background = element\_rect(fill = "white", color = "grey"), # Set strip background to white, # color = "black"  
 axis.ticks = element\_blank() # Remove x and y axis ticks  
 )}

# Part A: SFEB Microorganisms

## Data Wrangling

# make dataframe with only field data (milliq controls added into vis later)  
eb\_pw <- fs\_pw\_bd %>% filter(site != "sterile MQ")  
  
# dataframe for controls for labeling plot  
eb\_pw\_controls <- fs\_pw\_bd %>%   
 filter(site =="sterile MQ") %>%   
 pivot\_wider(names\_from = bd\_location, values\_from = bd\_qty) %>%  
 mutate(combined\_bd = adherent + floating) %>%   
 mutate(day = case\_when(  
 day == 1 ~ "Day\_1",  
 day == 7 ~ "Day\_7"))  
  
# data type cleaning  
eb\_pw$bd\_location <- factor(eb\_pw$bd\_location, levels = c("floating", "adherent"))  
eb\_pw$filter <- factor(eb\_pw$filter,  
 levels = c("40um\_filter", "0.22um\_filter"))  
eb\_pw$day <- factor(eb\_pw$day, levels = c("1", "7"),  
 labels = c("Day\_1", "Day\_7"))  
eb\_pw$site <- factor(eb\_pw$site,  
 levels = c("BARN", "CABIN", "NORTH", "GRAMPS", "WEST", "GDPND004", "GDPND005", "GDPND006", "GDPND008", "GDPND009", "PRPND002", "PRPND003", "PRPND004", "PRPND009", "PRPND010", "sterile MQ"))  
  
# get the total difference across days by combining both "locations" (adherent and supernatant) of Bd then subtracting across days  
eb\_pw\_total\_diff <- eb\_pw %>%  
 # combine floating and adherent for total\_Bd  
 pivot\_wider(names\_from = bd\_location, values\_from = bd\_qty) %>%  
 mutate(combined\_bd = adherent + floating) %>%   
 # remove uneeded columns  
 subset(select = -c(adherent,floating)) %>%   
  
# pivot wider to calculate the rate loss  
 pivot\_wider(names\_from = day, values\_from = combined\_bd) %>%  
 # calculate the rate loss by taking the log of each before subtracting  
 mutate(rate\_loss = log(Day\_1) - log(Day\_7))  
  
# Split into 2 data frames one for 40 um filter and one for .22 um filter for later stats assumption checks  
eb\_pw\_total\_diff\_40um <- eb\_pw\_total\_diff %>%   
 filter(filter =="40um\_filter")  
eb\_pw\_total\_diff.22um <- eb\_pw\_total\_diff%>%   
 filter(filter =="0.22um\_filter")  
  
# save clean data as a csv to use for publication figure  
write.csv(eb\_pw\_total\_diff, "data/eb\_pw\_total\_diff.csv", row.names = FALSE)

# SFEB EDA

## Assumption testing for stats

Question: Does the difference in Bd from day 1 to day 7 differ between the two filter types (40 and 0.22 um)?

The samples are essentially paired by site, so a paired t-test is most appropriate

Assumptions:

Assumes that the observations from each group represent a random sample from the population. Assumes that the difference of the two observations follow a normal distribution.

**Statistical question**: Is there a difference in the **rate of gain or loss of Bd over 6 days** between the **filter sizes** looking at the **TOTAL BD**

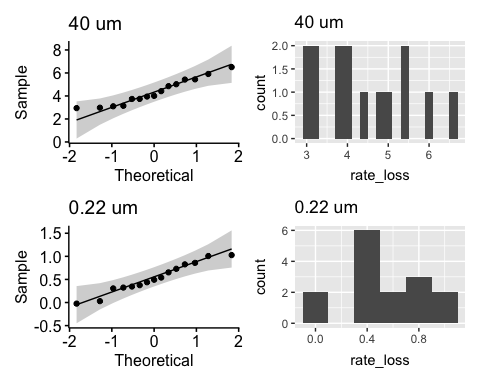
The samples are essentially paired by site, so a paired t-test is most appropriate

Assumptions:

Assumes that the observations from each group represent a random sample from the population. Assumes that the difference of the two observations follow a normal distribution.

Assumption testing:

# check normality of the differences across groups  
  
# numeric check  
eb\_pw\_40um\_shapiro.test <- shapiro.test(eb\_pw\_total\_diff\_40um$rate\_loss) # normal, yay!  
eb\_pw\_0.22um\_shapiro.test <- shapiro.test(eb\_pw\_total\_diff.22um$rate\_loss) # normal, yay!  
  
# visual check  
eb\_pw\_40um\_qq <- eb\_pw\_total\_diff\_40um %>%   
 ggqqplot("rate\_loss", title = "40 um") # normal, yay!  
  
# Histogram using ggplot2  
eb\_pw\_40um\_hist <- eb\_pw\_total\_diff\_40um %>%   
 ggplot(aes(x = rate\_loss)) +  
 geom\_histogram(binwidth = 0.2) +  
 labs(title = "40 um") # good enough, especially with confirmed shapiro and qq  
  
# visual check  
eb\_pw\_0.22um\_qq <- eb\_pw\_total\_diff.22um %>%   
 ggqqplot("rate\_loss", title = "0.22 um") # normal, yay!  
  
# Histogram using ggplot2  
eb\_pw\_0.22um\_hist <- eb\_pw\_total\_diff.22um %>%   
 ggplot(aes(x = rate\_loss)) +  
 geom\_histogram(binwidth = 0.2) +  
 labs(title = "0.22 um") # good enough, especially with confirmed shapiro and qq  
  
# show all assumption testing visualizations together  
eb\_pw\_40um\_qq + eb\_pw\_40um\_hist + eb\_pw\_0.22um\_qq + eb\_pw\_0.22um\_hist



# print shapiro test results  
eb\_pw\_40um\_shapiro.test

Shapiro-Wilk normality test  
  
data: eb\_pw\_total\_diff\_40um$rate\_loss  
W = 0.93591, p-value = 0.3337

eb\_pw\_0.22um\_shapiro.test

Shapiro-Wilk normality test  
  
data: eb\_pw\_total\_diff.22um$rate\_loss  
W = 0.96119, p-value = 0.7131

The data for the 40um filter is normally distributed (Shapiro-Wilk test, W = 0.93591, p = 0.3337), and so is the data for the 0.22 filter (Shapiro-Wilk test, W = 0.96119, p = 0.7131).

# Run the paired t-test on the difference across the 6 days  
eb\_pw\_paired\_ttest\_result <- t.test(eb\_pw\_total\_diff\_40um$rate\_loss, eb\_pw\_total\_diff.22um$rate\_loss, paired = TRUE)  
  
# print the result  
eb\_pw\_paired\_ttest\_result

Paired t-test  
  
data: eb\_pw\_total\_diff\_40um$rate\_loss and eb\_pw\_total\_diff.22um$rate\_loss  
t = 12.449, df = 14, p-value = 5.83e-09  
alternative hypothesis: true mean difference is not equal to 0  
95 percent confidence interval:  
 3.159637 4.474996  
sample estimates:  
mean difference   
 3.817316

**There is a significant difference in the change in the total quantity of Bd from Day 1 to Day 7 across the filter types (t = 12.4488129, df = 14, p-value = 5.8299032^{-9})**

The t-value is positive, which shows that the first item entered (with microbes) has a larger loss of Bd than the second item entered (no microbes.) Df of 14 is expected, because it’s 15 sites.

# Part B: SBNCOS AE microorganisms

## Data wrangling

pw <- sbncos\_raw %>%   
# add column for microbes presence yes or no  
 mutate(microbes = case\_when(  
 str\_detect(sample\_ID, "\\+microorganism") ~ "y", # if the raw data has microorganism in the sample id then it has microorganisms  
 TRUE ~ "n" # otherwise, it does not  
 )) %>%   
# add column for water\_treatment  
 mutate(water\_treatment = case\_when(  
 sample\_ID %in% c("1%TB", "MQ", "Added Bd") ~ "sterile-water", # these sample id's had a base of sterile water  
 sample\_ID %in% c("1%TB+PW+microorganism", "PW+microorganism") ~ "PW+MO", # these sample id's had pond water with microorganisms still present  
 sample\_ID %in% c("1%TB+PW-microorganism", "PW-microorganism") ~ "PW-MO" # these sample id's had filtered pond water aka pond water without microorganisms  
 )) %>%   
# add column for TB or no  
 mutate(TB = case\_when(  
 str\_detect(sample\_ID, "TB") ~ "y", # if the raw data has TB in the sample id then it has TB  
 TRUE ~ "n" # otherwise, it does not  
 )) %>%   
 # update day column to have the word Day in it  
 mutate(day = case\_when(  
 day == 1 ~ "Day\_1",  
 day == 3 ~ "Day\_3",  
 day == 5 ~ "Day\_5",  
 day == 7 ~ "Day\_7",  
 day == 0 ~ "Day\_0"  
 )) %>%   
 # also create a column with day as just a number  
 mutate(day\_numeric = as.numeric(gsub("Day\_", "", as.character(day))))  
  
## make a summary dataframe for ggplot creation  
pw\_summary <- pw %>%   
 group\_by(day, sample\_ID) %>%   
 reframe(mean = mean(adh\_plus\_sup), # calculate the mean  
 n = length(adh\_plus\_sup), # count the number of observations  
 df = n - 1, # calculate the degrees of freedom  
 sd = sd(adh\_plus\_sup), # calculate the standard deviation  
 se = sd/sqrt(n), # calculate the standard error  
 ) %>%   
 ## Now that it is in a new summarized format, recreate the columns made above  
 mutate(microbes = case\_when(  
 str\_detect(sample\_ID, "\\+microorganism") ~ "y",TRUE ~ "n")) %>%   
 # add column for TB or no  
 mutate(TB = case\_when(str\_detect(sample\_ID, "TB") ~ "y", TRUE ~ "n")) %>%   
 # add column for PW or no  
 mutate(water\_treatment = case\_when(  
 sample\_ID %in% c("1%TB", "MQ", "Added Bd") ~ "sterile-water",  
 sample\_ID %in% c("1%TB+PW+microorganism", "PW+microorganism") ~ "PW+MO",  
 sample\_ID %in% c("1%TB+PW-microorganism", "PW-microorganism") ~ "PW-MO"  
 )) %>%   
 mutate(day\_numeric = as.numeric(gsub("Day\_", "", as.character(day))))  
  
# dataframe of only controls, controls will be plotted separately on the plot  
pw\_control\_data <- pw %>%  
 filter(day == "Day\_0") %>%   
 mutate(day\_numeric = as.numeric(gsub("Day\_", "", as.character(day)))) %>%   
 dplyr::select(day, adh\_plus\_sup, day\_numeric)  
  
# dataframe without controls, controls will be plotted separately on the plot  
pw\_noday0 <- pw %>%  
 filter(day != "Day\_0") %>%  
 # log transform  
 # note: no zeroes so no +1 to the log needed  
 mutate(log\_adh\_plus\_sup = log(adh\_plus\_sup)) %>%   
 mutate(day = factor(day,   
 levels = c("Day\_1", "Day\_3", "Day\_5", "Day\_7")))  
  
# set MQ as reference for sample ID  
pw\_noday0$sample\_ID <- factor(pw\_noday0$sample\_ID)  
pw\_noday0$sample\_ID <- relevel(pw\_noday0$sample\_ID, ref = "MQ")  
  
# set sterile water as reference water treatment  
pw\_noday0$water\_treatment <- factor(pw\_noday0$water\_treatment)  
pw\_noday0$water\_treatment <- relevel(pw\_noday0$water\_treatment, ref = "sterile-water")  
  
# set no TB as reference  
pw\_noday0$TB <- factor(pw\_noday0$TB)  
pw\_noday0$TB <- relevel(pw\_noday0$TB, ref = "n")  
  
# set no microbes as reference  
pw\_noday0$microbes <- factor(pw\_noday0$microbes)  
pw\_noday0$microbes <- relevel(pw\_noday0$microbes, ref = "n")  
  
# export clean data for figure in another quarto doc  
write.csv(pw\_noday0, "data/pw\_noday0.csv", row.names = FALSE)

# Playing with figs

Renwei’s figure

|  |
| --- |
|  |

Caitlin’s version

fig\_2b <- pw\_summary %>%   
 # reorder to match Renwei's plot  
 mutate(sample\_ID = factor(sample\_ID,   
 levels = c("1%TB", "MQ", "1%TB+PW+microorganism", "PW+microorganism", "1%TB+PW-microorganism", "PW-microorganism", "Added Bd"))) %>%   
  
 ggplot(aes(x = day\_numeric,   
 y = mean,   
 color = sample\_ID)) +  
 geom\_point(size = 2) +  
 geom\_errorbar(aes(ymin = mean - se, # plot the standard error  
 ymax = mean + se),  
 width = 0.1) +  
 scale\_y\_log10(limits = c(1e3, 1e8),   
 breaks = c(1e3, 1e4, 1e5, 1e6, 1e7, 1e8)) +  
 # vibes  
 # vibes  
 labs(x = "Day",  
 y = "Bd Quantity per sample (ZE/well)",  
 color = "Medium", # Title for color legend  
 linetype = "Microbes Present" # Title for linetype legend  
 ) +  
 scale\_color\_manual(values = c("1%TB" = "#CCBB44",   
 "MQ" = "#228833",   
 "1%TB+PW+microorganism" = "#4477AA",   
 "PW+microorganism" = "#EE6677",   
 "1%TB+PW-microorganism" = "#66CCEE",  
 #"Added Bd" = "#BBBBBB" # removed bc not really a medium  
 "PW-microorganism" = "#AA3377"), # Assign specific colors to match RC's plot  
 labels = c("1%TB" = "TB",  
 "MQ" = "MQ",  
 "1%TB+PW+microorganism" = "TB + PW + MO",  
 "PW+microorganism" = "PW + MO",  
 "1%TB+PW-microorganism" = "TB + PW - MO",  
 "PW-microorganism" = "PW - MO",  
 "Added Bd" = "Initial Bd")) + # Custom labels for the color legend  
 geom\_line(aes(linetype = microbes)) +   
 scale\_linetype\_manual(values = c("n" = "dashed",   
 "y" = "solid"),  
 labels = c("n" = "N", "y" = "Y")) + # Change labels to uppercase N and Y  
 myCustomTheme()+  
 scale\_x\_continuous(breaks = c(0, 1, 3, 5, 7),  
 labels = c("Initial\nBd", "1", "3", "5", "7"))  
 theme(legend.position = "right") # Adjust the legend position to overlap with the plot

## SBNCOS EDA

visualize y variable: bd load

log transformed will get me closer to normal, so we will use that in the models! Note we only need to worry about the normality of *MODEL RESIDUALS* though which will be analyzed later on, so commented out the transformation and exploration of the data for space, feel free to uncomment and explore on your own though!

# # untransformed  
# ggqqplot(pw\_noday0, "adh\_plus\_sup", title = "untransformed")  
# shapiro.test(pw\_noday0$adh\_plus\_sup) # nope  
# hist(pw\_noday0$adh\_plus\_sup) # note  
#   
# # sqrt  
# hist(sqrt(pw\_noday0$adh\_plus\_sup)) # nope  
#   
# # log 10  
# hist(log10(pw\_noday0$adh\_plus\_sup)) # much better...?  
# shapiro.test(log10(pw\_noday0$adh\_plus\_sup)) # closer  
#   
# # log transformed  
# ggqqplot(pw\_noday0, "log\_adh\_plus\_sup", title = "log transformed") # gorgeous  
# hist(pw\_noday0$log\_adh\_plus\_sup) # better  
# shapiro.test(pw\_noday0$log\_adh\_plus\_sup) # p-value = 0.01361, does not pass shapiro, but this has an n of 72 which is more than the recommended <50 samples  
  
# visualize comparisons  
# TB y or n  
# pw\_noday0 %>%   
# ggplot(aes(x = TB,   
# y = log\_adh\_plus\_sup)) +  
# geom\_boxplot()  
# # water\_treat  
# pw\_noday0 %>%   
# ggplot(aes(x = water\_treatment,   
# y = log\_adh\_plus\_sup)) +  
# geom\_boxplot()  
# # day  
# pw\_noday0 %>%   
# ggplot(aes(x = day,   
# y = log\_adh\_plus\_sup)) +  
# geom\_boxplot()

## SBNCOS Stats & assumption testing

Most appropriate comparison for study design: day\*microbes\*water\_treatment

* y variable: amount of Bd
* x vars: day, TB y/n, water\_treatment (pw with microbes, pw without, sterile water)

Question: Does the amount of Bd in the sample differ across the treatments of presence of water type (pw with microbes, pw without, sterile water), TB, and day?

Model: 3-way anova

## null model

null <- lm(log\_adh\_plus\_sup ~ 1,  
 data = pw\_noday0)  
AIC(null) #326.4356

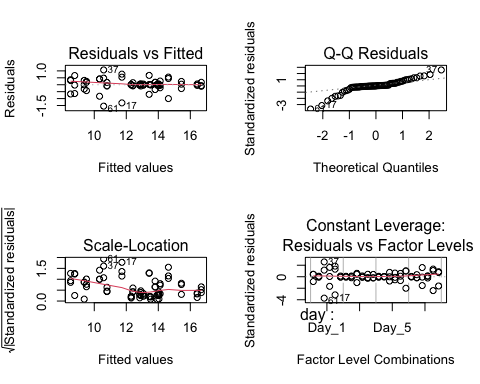
[1] 326.4356

## ANOVA with interactions: Bd ~ day\*TB\*water\_treatment

*Note: this ANOVA does not have perfectly normally distributed residuals, but it is the best tool we have to answer our question*

Note: Kruskall Wallace isn’t the best move here because we aim to analyze interactions, if I cut the interactions, a non-interaction anova does have the perfect residuals, so no need for a KW at all!

# log transformed  
aov\_sbncos <- aov(log\_adh\_plus\_sup ~ day\*TB\*water\_treatment,  
 data = pw\_noday0)  
  
# diagnostic plot  
par(mfrow = c(2,2))  
plot(aov\_sbncos) # qq is not ideal



AIC(aov\_sbncos) # better than null 127.7922

[1] 127.7922

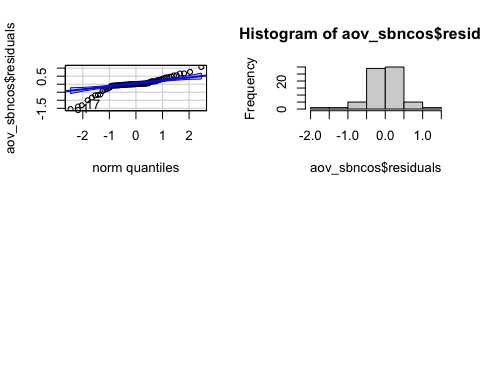
# make qq in car with 95% CI  
qqPlot(aov\_sbncos$residuals) # not ideal

[1] 61 17

hist(aov\_sbncos$residuals) # but this looks great!!  
shapiro.test(aov\_sbncos$residuals) # does not pass but shapiro isnt really appropriate here because n > 50

Shapiro-Wilk normality test  
  
data: aov\_sbncos$residuals  
W = 0.879, p-value = 4.861e-06

# try a sqrt transformed, did not work!  
# mod5 <- aov(sqrt(adh\_plus\_sup) ~ day\*TB\*water\_treatment,  
# data = pw\_noday0)  
#   
# # diagnostic plot  
# par(mfrow = c(2,2))  
# plot(mod5) # NOT normal...  
# AIC(mod5) # horrible 968.6406  
#   
# # make qq in car with 95% CI  
# qqPlot(mod5$residuals)



## anova results

# interpret results  
summary(aov\_sbncos)

Df Sum Sq Mean Sq F value Pr(>F)   
day 3 35.40 11.80 45.608 4.31e-14 \*\*\*  
TB 1 20.99 20.99 81.127 6.92e-12 \*\*\*  
water\_treatment 2 228.85 114.42 442.251 < 2e-16 \*\*\*  
day:TB 3 11.71 3.90 15.084 4.78e-07 \*\*\*  
day:water\_treatment 6 37.33 6.22 24.047 6.45e-13 \*\*\*  
TB:water\_treatment 2 0.06 0.03 0.109 0.897   
day:TB:water\_treatment 6 24.57 4.09 15.825 6.30e-10 \*\*\*  
Residuals 48 12.42 0.26   
---  
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

### post hoc

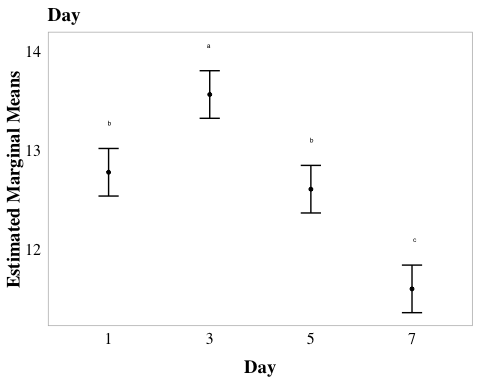
# post hoc  
TukeyHSD(aov\_sbncos)

Tukey multiple comparisons of means  
 95% family-wise confidence level  
  
Fit: aov(formula = log\_adh\_plus\_sup ~ day \* TB \* water\_treatment, data = pw\_noday0)  
  
$day  
 diff lwr upr p adj  
Day\_3-Day\_1 0.7878386 0.3365970 1.2390802 0.0001521  
Day\_5-Day\_1 -0.1715069 -0.6227485 0.2797347 0.7434984  
Day\_7-Day\_1 -1.1817503 -1.6329919 -0.7305087 0.0000000  
Day\_5-Day\_3 -0.9593455 -1.4105871 -0.5081039 0.0000049  
Day\_7-Day\_3 -1.9695889 -2.4208305 -1.5183474 0.0000000  
Day\_7-Day\_5 -1.0102434 -1.4614850 -0.5590018 0.0000017  
  
$TB  
 diff lwr upr p adj  
y-n 1.079872 0.8388136 1.32093 0  
  
$water\_treatment  
 diff lwr upr p adj  
PW-MO-sterile-water 0.340284 -0.01483837 0.6954063 0.0629087  
PW+MO-sterile-water -3.600293 -3.95541555 -3.2451709 0.0000000  
PW+MO-PW-MO -3.940577 -4.29569952 -3.5854549 0.0000000  
  
$`day:TB`  
 diff lwr upr p adj  
Day\_3:n-Day\_1:n -0.31984147 -1.07954248 0.43985955 0.8811923  
Day\_5:n-Day\_1:n -0.89827967 -1.65798069 -0.13857865 0.0104952  
Day\_7:n-Day\_1:n -1.64257839 -2.40227940 -0.88287737 0.0000003  
Day\_1:y-Day\_1:n -0.06776878 -0.82746980 0.69193223 0.9999917  
Day\_3:y-Day\_1:n 1.82774990 1.06804888 2.58745091 0.0000000  
Day\_5:y-Day\_1:n 0.48749705 -0.27220396 1.24719807 0.4714340  
Day\_7:y-Day\_1:n -0.78869107 -1.54839209 -0.02899005 0.0367370  
Day\_5:n-Day\_3:n -0.57843820 -1.33813922 0.18126282 0.2589734  
Day\_7:n-Day\_3:n -1.32273692 -2.08243794 -0.56303590 0.0000356  
Day\_1:y-Day\_3:n 0.25207268 -0.50762833 1.01177370 0.9635870  
Day\_3:y-Day\_3:n 2.14759136 1.38789035 2.90729238 0.0000000  
Day\_5:y-Day\_3:n 0.80733852 0.04763750 1.56703954 0.0299644  
Day\_7:y-Day\_3:n -0.46884960 -1.22855062 0.29085141 0.5214920  
Day\_7:n-Day\_5:n -0.74429872 -1.50399974 0.01540230 0.0586353  
Day\_1:y-Day\_5:n 0.83051089 0.07080987 1.59021190 0.0231296  
Day\_3:y-Day\_5:n 2.72602956 1.96632855 3.48573058 0.0000000  
Day\_5:y-Day\_5:n 1.38577672 0.62607571 2.14547774 0.0000144  
Day\_7:y-Day\_5:n 0.10958860 -0.65011242 0.86928962 0.9997851  
Day\_1:y-Day\_7:n 1.57480960 0.81510859 2.33451062 0.0000009  
Day\_3:y-Day\_7:n 3.47032828 2.71062727 4.23002930 0.0000000  
Day\_5:y-Day\_7:n 2.13007544 1.37037442 2.88977646 0.0000000  
Day\_7:y-Day\_7:n 0.85388732 0.09418630 1.61358833 0.0177057  
Day\_3:y-Day\_1:y 1.89551868 1.13581766 2.65521970 0.0000000  
Day\_5:y-Day\_1:y 0.55526584 -0.20443518 1.31496685 0.3066017  
Day\_7:y-Day\_1:y -0.72092229 -1.48062330 0.03877873 0.0742107  
Day\_5:y-Day\_3:y -1.34025284 -2.09995386 -0.58055182 0.0000277  
Day\_7:y-Day\_3:y -2.61644097 -3.37614198 -1.85673995 0.0000000  
Day\_7:y-Day\_5:y -1.27618812 -2.03588914 -0.51648711 0.0000691  
  
$`day:water\_treatment`  
 diff lwr upr  
Day\_3:sterile-water-Day\_1:sterile-water 1.56409952 0.55570514 2.572493908  
Day\_5:sterile-water-Day\_1:sterile-water -0.13666277 -1.14505716 0.871731612  
Day\_7:sterile-water-Day\_1:sterile-water -1.00670881 -2.01510319 0.001685579  
Day\_1:PW-MO-Day\_1:sterile-water -0.73277523 -1.74116961 0.275619158  
Day\_3:PW-MO-Day\_1:sterile-water 1.74122159 0.73282720 2.749615972  
Day\_5:PW-MO-Day\_1:sterile-water 0.86539619 -0.14299819 1.873790576  
Day\_7:PW-MO-Day\_1:sterile-water -0.09197876 -1.10037314 0.916415625  
Day\_1:PW+MO-Day\_1:sterile-water -1.78762409 -2.79601848 -0.779229708  
Day\_3:PW+MO-Day\_1:sterile-water -3.46220461 -4.47059900 -2.453810227  
Day\_5:PW+MO-Day\_1:sterile-water -3.76365348 -4.77204787 -2.755259100  
Day\_7:PW+MO-Day\_1:sterile-water -4.96696276 -5.97535715 -3.958568379  
Day\_5:sterile-water-Day\_3:sterile-water -1.70076230 -2.70915668 -0.692367913  
Day\_7:sterile-water-Day\_3:sterile-water -2.57080833 -3.57920271 -1.562413946  
Day\_1:PW-MO-Day\_3:sterile-water -2.29687475 -3.30526913 -1.288480366  
Day\_3:PW-MO-Day\_3:sterile-water 0.17712206 -0.83127232 1.185516448  
Day\_5:PW-MO-Day\_3:sterile-water -0.69870333 -1.70709772 0.309691052  
Day\_7:PW-MO-Day\_3:sterile-water -1.65607828 -2.66447267 -0.647683900  
Day\_1:PW+MO-Day\_3:sterile-water -3.35172362 -4.36011800 -2.343329232  
Day\_3:PW+MO-Day\_3:sterile-water -5.02630414 -6.03469852 -4.017909751  
Day\_5:PW+MO-Day\_3:sterile-water -5.32775301 -6.33614739 -4.319358624  
Day\_7:PW+MO-Day\_3:sterile-water -6.53106229 -7.53945667 -5.522667903  
Day\_7:sterile-water-Day\_5:sterile-water -0.87004603 -1.87844042 0.138348351  
Day\_1:PW-MO-Day\_5:sterile-water -0.59611245 -1.60450684 0.412281930  
Day\_3:PW-MO-Day\_5:sterile-water 1.87788436 0.86948998 2.886278745  
Day\_5:PW-MO-Day\_5:sterile-water 1.00205896 -0.00633542 2.010453348  
Day\_7:PW-MO-Day\_5:sterile-water 0.04468401 -0.96371037 1.053078397  
Day\_1:PW+MO-Day\_5:sterile-water -1.65096132 -2.65935570 -0.642566935  
Day\_3:PW+MO-Day\_5:sterile-water -3.32554184 -4.33393622 -2.317147455  
Day\_5:PW+MO-Day\_5:sterile-water -3.62699071 -4.63538510 -2.618596327  
Day\_7:PW+MO-Day\_5:sterile-water -4.83029999 -5.83869437 -3.821905606  
Day\_1:PW-MO-Day\_7:sterile-water 0.27393358 -0.73446080 1.282327963  
Day\_3:PW-MO-Day\_7:sterile-water 2.74793039 1.73953601 3.756324778  
Day\_5:PW-MO-Day\_7:sterile-water 1.87210500 0.86371061 2.880499381  
Day\_7:PW-MO-Day\_7:sterile-water 0.91473005 -0.09366434 1.923124430  
Day\_1:PW+MO-Day\_7:sterile-water -0.78091529 -1.78930967 0.227479098  
Day\_3:PW+MO-Day\_7:sterile-water -2.45549581 -3.46389019 -1.447101422  
Day\_5:PW+MO-Day\_7:sterile-water -2.75694468 -3.76533906 -1.748550294  
Day\_7:PW+MO-Day\_7:sterile-water -3.96025396 -4.96864834 -2.951859573  
Day\_3:PW-MO-Day\_1:PW-MO 2.47399681 1.46560243 3.482391198  
Day\_5:PW-MO-Day\_1:PW-MO 1.59817142 0.58977703 2.606565802  
Day\_7:PW-MO-Day\_1:PW-MO 0.64079647 -0.36759792 1.649190851  
Day\_1:PW+MO-Day\_1:PW-MO -1.05484887 -2.06324325 -0.046454482  
Day\_3:PW+MO-Day\_1:PW-MO -2.72942939 -3.73782377 -1.721035001  
Day\_5:PW+MO-Day\_1:PW-MO -3.03087826 -4.03927264 -2.022483874  
Day\_7:PW+MO-Day\_1:PW-MO -4.23418754 -5.24258192 -3.225793153  
Day\_5:PW-MO-Day\_3:PW-MO -0.87582540 -1.88421978 0.132568987  
Day\_7:PW-MO-Day\_3:PW-MO -1.83320035 -2.84159473 -0.824805964  
Day\_1:PW+MO-Day\_3:PW-MO -3.52884568 -4.53724006 -2.520451296  
Day\_3:PW+MO-Day\_3:PW-MO -5.20342620 -6.21182058 -4.195031816  
Day\_5:PW+MO-Day\_3:PW-MO -5.50487507 -6.51326946 -4.496480688  
Day\_7:PW+MO-Day\_3:PW-MO -6.70818435 -7.71657874 -5.699789967  
Day\_7:PW-MO-Day\_5:PW-MO -0.95737495 -1.96576934 0.051019433  
Day\_1:PW+MO-Day\_5:PW-MO -2.65302028 -3.66141467 -1.644625900  
Day\_3:PW+MO-Day\_5:PW-MO -4.32760080 -5.33599519 -3.319206419  
Day\_5:PW+MO-Day\_5:PW-MO -4.62904968 -5.63744406 -3.620655292  
Day\_7:PW+MO-Day\_5:PW-MO -5.83235895 -6.84075334 -4.823964571  
Day\_1:PW+MO-Day\_7:PW-MO -1.69564533 -2.70403972 -0.687250948  
Day\_3:PW+MO-Day\_7:PW-MO -3.37022585 -4.37862024 -2.361831468  
Day\_5:PW+MO-Day\_7:PW-MO -3.67167472 -4.68006911 -2.663280340  
Day\_7:PW+MO-Day\_7:PW-MO -4.87498400 -5.88337839 -3.866589619  
Day\_3:PW+MO-Day\_1:PW+MO -1.67458052 -2.68297490 -0.666186136  
Day\_5:PW+MO-Day\_1:PW+MO -1.97602939 -2.98442378 -0.967635008  
Day\_7:PW+MO-Day\_1:PW+MO -3.17933867 -4.18773306 -2.170944287  
Day\_5:PW+MO-Day\_3:PW+MO -0.30144887 -1.30984326 0.706945511  
Day\_7:PW+MO-Day\_3:PW+MO -1.50475815 -2.51315254 -0.496363768  
Day\_7:PW+MO-Day\_5:PW+MO -1.20330928 -2.21170366 -0.194914895  
 p adj  
Day\_3:sterile-water-Day\_1:sterile-water 0.0001540  
Day\_5:sterile-water-Day\_1:sterile-water 0.9999983  
Day\_7:sterile-water-Day\_1:sterile-water 0.0507394  
Day\_1:PW-MO-Day\_1:sterile-water 0.3673389  
Day\_3:PW-MO-Day\_1:sterile-water 0.0000195  
Day\_5:PW-MO-Day\_1:sterile-water 0.1573217  
Day\_7:PW-MO-Day\_1:sterile-water 1.0000000  
Day\_1:PW+MO-Day\_1:sterile-water 0.0000113  
Day\_3:PW+MO-Day\_1:sterile-water 0.0000000  
Day\_5:PW+MO-Day\_1:sterile-water 0.0000000  
Day\_7:PW+MO-Day\_1:sterile-water 0.0000000  
Day\_5:sterile-water-Day\_3:sterile-water 0.0000315  
Day\_7:sterile-water-Day\_3:sterile-water 0.0000000  
Day\_1:PW-MO-Day\_3:sterile-water 0.0000000  
Day\_3:PW-MO-Day\_3:sterile-water 0.9999751  
Day\_5:PW-MO-Day\_3:sterile-water 0.4388765  
Day\_7:PW-MO-Day\_3:sterile-water 0.0000531  
Day\_1:PW+MO-Day\_3:sterile-water 0.0000000  
Day\_3:PW+MO-Day\_3:sterile-water 0.0000000  
Day\_5:PW+MO-Day\_3:sterile-water 0.0000000  
Day\_7:PW+MO-Day\_3:sterile-water 0.0000000  
Day\_7:sterile-water-Day\_5:sterile-water 0.1520910  
Day\_1:PW-MO-Day\_5:sterile-water 0.6716810  
Day\_3:PW-MO-Day\_5:sterile-water 0.0000039  
Day\_5:PW-MO-Day\_5:sterile-water 0.0528293  
Day\_7:PW-MO-Day\_5:sterile-water 1.0000000  
Day\_1:PW+MO-Day\_5:sterile-water 0.0000563  
Day\_3:PW+MO-Day\_5:sterile-water 0.0000000  
Day\_5:PW+MO-Day\_5:sterile-water 0.0000000  
Day\_7:PW+MO-Day\_5:sterile-water 0.0000000  
Day\_1:PW-MO-Day\_7:sterile-water 0.9983727  
Day\_3:PW-MO-Day\_7:sterile-water 0.0000000  
Day\_5:PW-MO-Day\_7:sterile-water 0.0000041  
Day\_7:PW-MO-Day\_7:sterile-water 0.1085209  
Day\_1:PW+MO-Day\_7:sterile-water 0.2775082  
Day\_3:PW+MO-Day\_7:sterile-water 0.0000000  
Day\_5:PW+MO-Day\_7:sterile-water 0.0000000  
Day\_7:PW+MO-Day\_7:sterile-water 0.0000000  
Day\_3:PW-MO-Day\_1:PW-MO 0.0000000  
Day\_5:PW-MO-Day\_1:PW-MO 0.0001040  
Day\_7:PW-MO-Day\_1:PW-MO 0.5697876  
Day\_1:PW+MO-Day\_1:PW-MO 0.0330451  
Day\_3:PW+MO-Day\_1:PW-MO 0.0000000  
Day\_5:PW+MO-Day\_1:PW-MO 0.0000000  
Day\_7:PW+MO-Day\_1:PW-MO 0.0000000  
Day\_5:PW-MO-Day\_3:PW-MO 0.1457799  
Day\_7:PW-MO-Day\_3:PW-MO 0.0000066  
Day\_1:PW+MO-Day\_3:PW-MO 0.0000000  
Day\_3:PW+MO-Day\_3:PW-MO 0.0000000  
Day\_5:PW+MO-Day\_3:PW-MO 0.0000000  
Day\_7:PW+MO-Day\_3:PW-MO 0.0000000  
Day\_7:PW-MO-Day\_5:PW-MO 0.0770752  
Day\_1:PW+MO-Day\_5:PW-MO 0.0000000  
Day\_3:PW+MO-Day\_5:PW-MO 0.0000000  
Day\_5:PW+MO-Day\_5:PW-MO 0.0000000  
Day\_7:PW+MO-Day\_5:PW-MO 0.0000000  
Day\_1:PW+MO-Day\_7:PW-MO 0.0000334  
Day\_3:PW+MO-Day\_7:PW-MO 0.0000000  
Day\_5:PW+MO-Day\_7:PW-MO 0.0000000  
Day\_7:PW+MO-Day\_7:PW-MO 0.0000000  
Day\_3:PW+MO-Day\_1:PW+MO 0.0000428  
Day\_5:PW+MO-Day\_1:PW+MO 0.0000012  
Day\_7:PW+MO-Day\_1:PW+MO 0.0000000  
Day\_5:PW+MO-Day\_3:PW+MO 0.9962387  
Day\_7:PW+MO-Day\_3:PW+MO 0.0003034  
Day\_7:PW+MO-Day\_5:PW+MO 0.0078960  
  
$`TB:water\_treatment`  
 diff lwr upr p adj  
y:sterile-water-n:sterile-water 1.0008405 0.3845328 1.6171483 0.0002063  
n:PW-MO-n:sterile-water 0.2793426 -0.3369651 0.8956503 0.7585152  
y:PW-MO-n:sterile-water 1.4020658 0.7857581 2.0183736 0.0000003  
n:PW+MO-n:sterile-water -3.6578986 -4.2742063 -3.0415908 0.0000000  
y:PW+MO-n:sterile-water -2.5418473 -3.1581551 -1.9255396 0.0000000  
n:PW-MO-y:sterile-water -0.7214979 -1.3378056 -0.1051902 0.0131854  
y:PW-MO-y:sterile-water 0.4012253 -0.2150824 1.0175330 0.3958413  
n:PW+MO-y:sterile-water -4.6587391 -5.2750468 -4.0424314 0.0000000  
y:PW+MO-y:sterile-water -3.5426879 -4.1589956 -2.9263802 0.0000000  
y:PW-MO-n:PW-MO 1.1227232 0.5064155 1.7390309 0.0000284  
n:PW+MO-n:PW-MO -3.9372412 -4.5535489 -3.3209335 0.0000000  
y:PW+MO-n:PW-MO -2.8211900 -3.4374977 -2.2048822 0.0000000  
n:PW+MO-y:PW-MO -5.0599644 -5.6762721 -4.4436567 0.0000000  
y:PW+MO-y:PW-MO -3.9439132 -4.5602209 -3.3276055 0.0000000  
y:PW+MO-n:PW+MO 1.1160512 0.4997435 1.7323589 0.0000317  
  
$`day:TB:water\_treatment`  
 diff lwr upr  
Day\_3:n:sterile-water-Day\_1:n:sterile-water 0.12748302 -1.47333045 1.72829649  
Day\_5:n:sterile-water-Day\_1:n:sterile-water -0.95922474 -2.56003820 0.64158873  
Day\_7:n:sterile-water-Day\_1:n:sterile-water -1.49396778 -3.09478124 0.10684569  
Day\_1:y:sterile-water-Day\_1:n:sterile-water -0.37237819 -1.97319165 1.22843528  
Day\_3:y:sterile-water-Day\_1:n:sterile-water 2.62833784 1.02752437 4.22915131  
Day\_5:y:sterile-water-Day\_1:n:sterile-water 0.31352101 -1.28729246 1.91433447  
Day\_7:y:sterile-water-Day\_1:n:sterile-water -0.89182802 -2.49264149 0.70898545  
Day\_1:n:PW-MO-Day\_1:n:sterile-water 0.23735219 -1.36346128 1.83816566  
Day\_3:n:PW-MO-Day\_1:n:sterile-water 0.22486268 -1.37595078 1.82567615  
Day\_5:n:PW-MO-Day\_1:n:sterile-water -0.28368820 -1.88450167 1.31712526  
Day\_7:n:PW-MO-Day\_1:n:sterile-water -1.38686565 -2.98767912 0.21394782  
Day\_1:y:PW-MO-Day\_1:n:sterile-water -2.07528082 -3.67609429 -0.47446736  
Day\_3:y:PW-MO-Day\_1:n:sterile-water 2.88520231 1.28438884 4.48601578  
Day\_5:y:PW-MO-Day\_1:n:sterile-water 1.64210240 0.04128893 3.24291587  
Day\_7:y:PW-MO-Day\_1:n:sterile-water 0.83052995 -0.77028352 2.43134342  
Day\_1:n:PW+MO-Day\_1:n:sterile-water -3.21466561 -4.81547908 -1.61385214  
Day\_3:n:PW+MO-Day\_1:n:sterile-water -4.28918353 -5.88999699 -2.68837006  
Day\_5:n:PW+MO-Day\_1:n:sterile-water -4.42923949 -6.03005295 -2.82842602  
Day\_7:n:PW+MO-Day\_1:n:sterile-water -5.02421515 -6.62502862 -3.42340168  
Day\_1:y:PW+MO-Day\_1:n:sterile-water -0.73296076 -2.33377423 0.86785271  
Day\_3:y:PW+MO-Day\_1:n:sterile-water -3.00760388 -4.60841735 -1.40679041  
Day\_5:y:PW+MO-Day\_1:n:sterile-water -3.47044567 -5.07125913 -1.86963220  
Day\_7:y:PW+MO-Day\_1:n:sterile-water -5.28208856 -6.88290203 -3.68127509  
Day\_5:n:sterile-water-Day\_3:n:sterile-water -1.08670776 -2.68752123 0.51410571  
Day\_7:n:sterile-water-Day\_3:n:sterile-water -1.62145080 -3.22226426 -0.02063733  
Day\_1:y:sterile-water-Day\_3:n:sterile-water -0.49986121 -2.10067467 1.10095226  
Day\_3:y:sterile-water-Day\_3:n:sterile-water 2.50085482 0.90004135 4.10166829  
Day\_5:y:sterile-water-Day\_3:n:sterile-water 0.18603799 -1.41477548 1.78685145  
Day\_7:y:sterile-water-Day\_3:n:sterile-water -1.01931104 -2.62012451 0.58150243  
Day\_1:n:PW-MO-Day\_3:n:sterile-water 0.10986917 -1.49094430 1.71068263  
Day\_3:n:PW-MO-Day\_3:n:sterile-water 0.09737966 -1.50343381 1.69819313  
Day\_5:n:PW-MO-Day\_3:n:sterile-water -0.41117123 -2.01198469 1.18964224  
Day\_7:n:PW-MO-Day\_3:n:sterile-water -1.51434867 -3.11516214 0.08646479  
Day\_1:y:PW-MO-Day\_3:n:sterile-water -2.20276385 -3.80357731 -0.60195038  
Day\_3:y:PW-MO-Day\_3:n:sterile-water 2.75771929 1.15690582 4.35853275  
Day\_5:y:PW-MO-Day\_3:n:sterile-water 1.51461938 -0.08619409 3.11543285  
Day\_7:y:PW-MO-Day\_3:n:sterile-water 0.70304693 -0.89776654 2.30386040  
Day\_1:n:PW+MO-Day\_3:n:sterile-water -3.34214863 -4.94296210 -1.74133516  
Day\_3:n:PW+MO-Day\_3:n:sterile-water -4.41666655 -6.01748001 -2.81585308  
Day\_5:n:PW+MO-Day\_3:n:sterile-water -4.55672251 -6.15753597 -2.95590904  
Day\_7:n:PW+MO-Day\_3:n:sterile-water -5.15169817 -6.75251164 -3.55088470  
Day\_1:y:PW+MO-Day\_3:n:sterile-water -0.86044378 -2.46125725 0.74036969  
Day\_3:y:PW+MO-Day\_3:n:sterile-water -3.13508690 -4.73590037 -1.53427344  
Day\_5:y:PW+MO-Day\_3:n:sterile-water -3.59792869 -5.19874216 -1.99711522  
Day\_7:y:PW+MO-Day\_3:n:sterile-water -5.40957158 -7.01038505 -3.80875811  
Day\_7:n:sterile-water-Day\_5:n:sterile-water -0.53474304 -2.13555651 1.06607043  
Day\_1:y:sterile-water-Day\_5:n:sterile-water 0.58684655 -1.01396692 2.18766002  
Day\_3:y:sterile-water-Day\_5:n:sterile-water 3.58756258 1.98674911 5.18837605  
Day\_5:y:sterile-water-Day\_5:n:sterile-water 1.27274574 -0.32806772 2.87355921  
Day\_7:y:sterile-water-Day\_5:n:sterile-water 0.06739672 -1.53341675 1.66821018  
Day\_1:n:PW-MO-Day\_5:n:sterile-water 1.19657692 -0.40423654 2.79739039  
Day\_3:n:PW-MO-Day\_5:n:sterile-water 1.18408742 -0.41672605 2.78490089  
Day\_5:n:PW-MO-Day\_5:n:sterile-water 0.67553653 -0.92527694 2.27635000  
Day\_7:n:PW-MO-Day\_5:n:sterile-water -0.42764092 -2.02845438 1.17317255  
Day\_1:y:PW-MO-Day\_5:n:sterile-water -1.11605609 -2.71686956 0.48475738  
Day\_3:y:PW-MO-Day\_5:n:sterile-water 3.84442704 2.24361358 5.44524051  
Day\_5:y:PW-MO-Day\_5:n:sterile-water 2.60132714 1.00051367 4.20214061  
Day\_7:y:PW-MO-Day\_5:n:sterile-water 1.78975469 0.18894122 3.39056815  
Day\_1:n:PW+MO-Day\_5:n:sterile-water -2.25544087 -3.85625434 -0.65462740  
Day\_3:n:PW+MO-Day\_5:n:sterile-water -3.32995879 -4.93077226 -1.72914532  
Day\_5:n:PW+MO-Day\_5:n:sterile-water -3.47001475 -5.07082822 -1.86920128  
Day\_7:n:PW+MO-Day\_5:n:sterile-water -4.06499041 -5.66580388 -2.46417695  
Day\_1:y:PW+MO-Day\_5:n:sterile-water 0.22626398 -1.37454949 1.82707744  
Day\_3:y:PW+MO-Day\_5:n:sterile-water -2.04837915 -3.64919261 -0.44756568  
Day\_5:y:PW+MO-Day\_5:n:sterile-water -2.51122093 -4.11203440 -0.91040746  
Day\_7:y:PW+MO-Day\_5:n:sterile-water -4.32286382 -5.92367729 -2.72205035  
Day\_1:y:sterile-water-Day\_7:n:sterile-water 1.12158959 -0.47922388 2.72240306  
Day\_3:y:sterile-water-Day\_7:n:sterile-water 4.12230562 2.52149215 5.72311909  
Day\_5:y:sterile-water-Day\_7:n:sterile-water 1.80748878 0.20667531 3.40830225  
Day\_7:y:sterile-water-Day\_7:n:sterile-water 0.60213976 -0.99867371 2.20295322  
Day\_1:n:PW-MO-Day\_7:n:sterile-water 1.73131996 0.13050650 3.33213343  
Day\_3:n:PW-MO-Day\_7:n:sterile-water 1.71883046 0.11801699 3.31964393  
Day\_5:n:PW-MO-Day\_7:n:sterile-water 1.21027957 -0.39053390 2.81109304  
Day\_7:n:PW-MO-Day\_7:n:sterile-water 0.10710212 -1.49371134 1.70791559  
Day\_1:y:PW-MO-Day\_7:n:sterile-water -0.58131305 -2.18212652 1.01950042  
Day\_3:y:PW-MO-Day\_7:n:sterile-water 4.37917008 2.77835662 5.97998355  
Day\_5:y:PW-MO-Day\_7:n:sterile-water 3.13607018 1.53525671 4.73688365  
Day\_7:y:PW-MO-Day\_7:n:sterile-water 2.32449772 0.72368426 3.92531119  
Day\_1:n:PW+MO-Day\_7:n:sterile-water -1.72069783 -3.32151130 -0.11988436  
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Day\_3:y:sterile-water-Day\_1:n:sterile-water 0.0000192  
Day\_5:y:sterile-water-Day\_1:n:sterile-water 1.0000000  
Day\_7:y:sterile-water-Day\_1:n:sterile-water 0.8753436  
Day\_1:n:PW-MO-Day\_1:n:sterile-water 1.0000000  
Day\_3:n:PW-MO-Day\_1:n:sterile-water 1.0000000  
Day\_5:n:PW-MO-Day\_1:n:sterile-water 1.0000000  
Day\_7:n:PW-MO-Day\_1:n:sterile-water 0.1723490  
Day\_1:y:PW-MO-Day\_1:n:sterile-water 0.0016944  
Day\_3:y:PW-MO-Day\_1:n:sterile-water 0.0000022  
Day\_5:y:PW-MO-Day\_1:n:sterile-water 0.0383727  
Day\_7:y:PW-MO-Day\_1:n:sterile-water 0.9304923  
Day\_1:n:PW+MO-Day\_1:n:sterile-water 0.0000001  
Day\_3:n:PW+MO-Day\_1:n:sterile-water 0.0000000  
Day\_5:n:PW+MO-Day\_1:n:sterile-water 0.0000000  
Day\_7:n:PW+MO-Day\_1:n:sterile-water 0.0000000  
Day\_1:y:PW+MO-Day\_1:n:sterile-water 0.9795458  
Day\_3:y:PW+MO-Day\_1:n:sterile-water 0.0000008  
Day\_5:y:PW+MO-Day\_1:n:sterile-water 0.0000000  
Day\_7:y:PW+MO-Day\_1:n:sterile-water 0.0000000  
Day\_5:n:sterile-water-Day\_3:n:sterile-water 0.5893047  
Day\_7:n:sterile-water-Day\_3:n:sterile-water 0.0438443  
Day\_1:y:sterile-water-Day\_3:n:sterile-water 0.9998839  
Day\_3:y:sterile-water-Day\_3:n:sterile-water 0.0000552  
Day\_5:y:sterile-water-Day\_3:n:sterile-water 1.0000000  
Day\_7:y:sterile-water-Day\_3:n:sterile-water 0.7013754  
Day\_1:n:PW-MO-Day\_3:n:sterile-water 1.0000000  
Day\_3:n:PW-MO-Day\_3:n:sterile-water 1.0000000  
Day\_5:n:PW-MO-Day\_3:n:sterile-water 0.9999958  
Day\_7:n:PW-MO-Day\_3:n:sterile-water 0.0848700  
Day\_1:y:PW-MO-Day\_3:n:sterile-water 0.0006225  
Day\_3:y:PW-MO-Day\_3:n:sterile-water 0.0000065  
Day\_5:y:PW-MO-Day\_3:n:sterile-water 0.0847344  
Day\_7:y:PW-MO-Day\_3:n:sterile-water 0.9871203  
Day\_1:n:PW+MO-Day\_3:n:sterile-water 0.0000000  
Day\_3:n:PW+MO-Day\_3:n:sterile-water 0.0000000  
Day\_5:n:PW+MO-Day\_3:n:sterile-water 0.0000000  
Day\_7:n:PW+MO-Day\_3:n:sterile-water 0.0000000  
Day\_1:y:PW+MO-Day\_3:n:sterile-water 0.9061180  
Day\_3:y:PW+MO-Day\_3:n:sterile-water 0.0000003  
Day\_5:y:PW+MO-Day\_3:n:sterile-water 0.0000000  
Day\_7:y:PW+MO-Day\_3:n:sterile-water 0.0000000  
Day\_7:n:sterile-water-Day\_5:n:sterile-water 0.9996681  
Day\_1:y:sterile-water-Day\_5:n:sterile-water 0.9987106  
Day\_3:y:sterile-water-Day\_5:n:sterile-water 0.0000000  
Day\_5:y:sterile-water-Day\_5:n:sterile-water 0.2981239  
Day\_7:y:sterile-water-Day\_5:n:sterile-water 1.0000000  
Day\_1:n:PW-MO-Day\_5:n:sterile-water 0.4077348  
Day\_3:n:PW-MO-Day\_5:n:sterile-water 0.4273429  
Day\_5:n:PW-MO-Day\_5:n:sterile-water 0.9919330  
Day\_7:n:PW-MO-Day\_5:n:sterile-water 0.9999915  
Day\_1:y:PW-MO-Day\_5:n:sterile-water 0.5394993  
Day\_3:y:PW-MO-Day\_5:n:sterile-water 0.0000000  
Day\_5:y:PW-MO-Day\_5:n:sterile-water 0.0000240  
Day\_7:y:PW-MO-Day\_5:n:sterile-water 0.0141042  
Day\_1:n:PW+MO-Day\_5:n:sterile-water 0.0004086  
Day\_3:n:PW+MO-Day\_5:n:sterile-water 0.0000001  
Day\_5:n:PW+MO-Day\_5:n:sterile-water 0.0000000  
Day\_7:n:PW+MO-Day\_5:n:sterile-water 0.0000000  
Day\_1:y:PW+MO-Day\_5:n:sterile-water 1.0000000  
Day\_3:y:PW+MO-Day\_5:n:sterile-water 0.0020854  
Day\_5:y:PW+MO-Day\_5:n:sterile-water 0.0000507  
Day\_7:y:PW+MO-Day\_5:n:sterile-water 0.0000000  
Day\_1:y:sterile-water-Day\_7:n:sterile-water 0.5301471  
Day\_3:y:sterile-water-Day\_7:n:sterile-water 0.0000000  
Day\_5:y:sterile-water-Day\_7:n:sterile-water 0.0124434  
Day\_7:y:sterile-water-Day\_7:n:sterile-water 0.9981598  
Day\_1:n:PW-MO-Day\_7:n:sterile-water 0.0211573  
Day\_3:n:PW-MO-Day\_7:n:sterile-water 0.0230377  
Day\_5:n:PW-MO-Day\_7:n:sterile-water 0.3866947  
Day\_7:n:PW-MO-Day\_7:n:sterile-water 1.0000000  
Day\_1:y:PW-MO-Day\_7:n:sterile-water 0.9988714  
Day\_3:y:PW-MO-Day\_7:n:sterile-water 0.0000000  
Day\_5:y:PW-MO-Day\_7:n:sterile-water 0.0000003  
Day\_7:y:PW-MO-Day\_7:n:sterile-water 0.0002341  
Day\_1:n:PW+MO-Day\_7:n:sterile-water 0.0227471  
Day\_3:n:PW+MO-Day\_7:n:sterile-water 0.0000048  
Day\_5:n:PW+MO-Day\_7:n:sterile-water 0.0000015  
Day\_7:n:PW+MO-Day\_7:n:sterile-water 0.0000000  
Day\_1:y:PW+MO-Day\_7:n:sterile-water 0.9696777  
Day\_3:y:PW+MO-Day\_7:n:sterile-water 0.0852279  
Day\_5:y:PW+MO-Day\_7:n:sterile-water 0.0036067  
Day\_7:y:PW+MO-Day\_7:n:sterile-water 0.0000000  
Day\_3:y:sterile-water-Day\_1:y:sterile-water 0.0000008  
Day\_5:y:sterile-water-Day\_1:y:sterile-water 0.9903299  
Day\_7:y:sterile-water-Day\_1:y:sterile-water 0.9997874  
Day\_1:n:PW-MO-Day\_1:y:sterile-water 0.9978188  
Day\_3:n:PW-MO-Day\_1:y:sterile-water 0.9983547  
Day\_5:n:PW-MO-Day\_1:y:sterile-water 1.0000000  
Day\_7:n:PW-MO-Day\_1:y:sterile-water 0.7090765  
Day\_1:y:PW-MO-Day\_1:y:sterile-water 0.0256590  
Day\_3:y:PW-MO-Day\_1:y:sterile-water 0.0000001  
Day\_5:y:PW-MO-Day\_1:y:sterile-water 0.0027036  
Day\_7:y:PW-MO-Day\_1:y:sterile-water 0.3979493  
Day\_1:n:PW+MO-Day\_1:y:sterile-water 0.0000032  
Day\_3:n:PW+MO-Day\_1:y:sterile-water 0.0000000  
Day\_5:n:PW+MO-Day\_1:y:sterile-water 0.0000000  
Day\_7:n:PW+MO-Day\_1:y:sterile-water 0.0000000  
Day\_1:y:PW+MO-Day\_1:y:sterile-water 0.9999996  
Day\_3:y:PW+MO-Day\_1:y:sterile-water 0.0000181  
Day\_5:y:PW+MO-Day\_1:y:sterile-water 0.0000004  
Day\_7:y:PW+MO-Day\_1:y:sterile-water 0.0000000  
Day\_5:y:sterile-water-Day\_3:y:sterile-water 0.0002532  
Day\_7:y:sterile-water-Day\_3:y:sterile-water 0.0000000  
Day\_1:n:PW-MO-Day\_3:y:sterile-water 0.0001362  
Day\_3:n:PW-MO-Day\_3:y:sterile-water 0.0001230  
Day\_5:n:PW-MO-Day\_3:y:sterile-water 0.0000018  
Day\_7:n:PW-MO-Day\_3:y:sterile-water 0.0000000  
Day\_1:y:PW-MO-Day\_3:y:sterile-water 0.0000000  
Day\_3:y:PW-MO-Day\_3:y:sterile-water 1.0000000  
Day\_5:y:PW-MO-Day\_3:y:sterile-water 0.7528131  
Day\_7:y:PW-MO-Day\_3:y:sterile-water 0.0133258  
Day\_1:n:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_3:n:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_5:n:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_7:n:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_1:y:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_3:y:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_5:y:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_7:y:PW+MO-Day\_3:y:sterile-water 0.0000000  
Day\_7:y:sterile-water-Day\_5:y:sterile-water 0.3942057  
Day\_1:n:PW-MO-Day\_5:y:sterile-water 1.0000000  
Day\_3:n:PW-MO-Day\_5:y:sterile-water 1.0000000  
Day\_5:n:PW-MO-Day\_5:y:sterile-water 0.9983559  
Day\_7:n:PW-MO-Day\_5:y:sterile-water 0.0260973  
Day\_1:y:PW-MO-Day\_5:y:sterile-water 0.0001387  
Day\_3:y:PW-MO-Day\_5:y:sterile-water 0.0000307  
Day\_5:y:PW-MO-Day\_5:y:sterile-water 0.2305634  
Day\_7:y:PW-MO-Day\_5:y:sterile-water 0.9998024  
Day\_1:n:PW+MO-Day\_5:y:sterile-water 0.0000000  
Day\_3:n:PW+MO-Day\_5:y:sterile-water 0.0000000  
Day\_5:n:PW+MO-Day\_5:y:sterile-water 0.0000000  
Day\_7:n:PW+MO-Day\_5:y:sterile-water 0.0000000  
Day\_1:y:PW+MO-Day\_5:y:sterile-water 0.6570027  
Day\_3:y:PW+MO-Day\_5:y:sterile-water 0.0000001  
Day\_5:y:PW+MO-Day\_5:y:sterile-water 0.0000000  
Day\_7:y:PW+MO-Day\_5:y:sterile-water 0.0000000  
Day\_1:n:PW-MO-Day\_7:y:sterile-water 0.5173594  
Day\_3:n:PW-MO-Day\_7:y:sterile-water 0.5384257  
Day\_5:n:PW-MO-Day\_7:y:sterile-water 0.9978944  
Day\_7:n:PW-MO-Day\_7:y:sterile-water 0.9999006  
Day\_1:y:PW-MO-Day\_7:y:sterile-water 0.4283495  
Day\_3:y:PW-MO-Day\_7:y:sterile-water 0.0000000  
Day\_5:y:PW-MO-Day\_7:y:sterile-water 0.0000420  
Day\_7:y:PW-MO-Day\_7:y:sterile-water 0.0224915  
Day\_1:n:PW+MO-Day\_7:y:sterile-water 0.0002373  
Day\_3:n:PW+MO-Day\_7:y:sterile-water 0.0000000  
Day\_5:n:PW+MO-Day\_7:y:sterile-water 0.0000000  
Day\_7:n:PW+MO-Day\_7:y:sterile-water 0.0000000  
Day\_1:y:PW+MO-Day\_7:y:sterile-water 1.0000000  
Day\_3:y:PW+MO-Day\_7:y:sterile-water 0.0012364  
Day\_5:y:PW+MO-Day\_7:y:sterile-water 0.0000290  
Day\_7:y:PW+MO-Day\_7:y:sterile-water 0.0000000  
Day\_3:n:PW-MO-Day\_1:n:PW-MO 1.0000000  
Day\_5:n:PW-MO-Day\_1:n:PW-MO 0.9997770  
Day\_7:n:PW-MO-Day\_1:n:PW-MO 0.0430727  
Day\_1:y:PW-MO-Day\_1:n:PW-MO 0.0002577  
Day\_3:y:PW-MO-Day\_1:n:PW-MO 0.0000163  
Day\_5:y:PW-MO-Day\_1:n:PW-MO 0.1569390  
Day\_7:y:PW-MO-Day\_1:n:PW-MO 0.9985027  
Day\_1:n:PW+MO-Day\_1:n:PW-MO 0.0000000  
Day\_3:n:PW+MO-Day\_1:n:PW-MO 0.0000000  
Day\_5:n:PW+MO-Day\_1:n:PW-MO 0.0000000  
Day\_7:n:PW+MO-Day\_1:n:PW-MO 0.0000000  
Day\_1:y:PW+MO-Day\_1:n:PW-MO 0.7762575  
Day\_3:y:PW+MO-Day\_1:n:PW-MO 0.0000001  
Day\_5:y:PW+MO-Day\_1:n:PW-MO 0.0000000  
Day\_7:y:PW+MO-Day\_1:n:PW-MO 0.0000000  
Day\_5:n:PW-MO-Day\_3:n:PW-MO 0.9998474  
Day\_7:n:PW-MO-Day\_3:n:PW-MO 0.0466545  
Day\_1:y:PW-MO-Day\_3:n:PW-MO 0.0002851  
Day\_3:y:PW-MO-Day\_3:n:PW-MO 0.0000147  
Day\_5:y:PW-MO-Day\_3:n:PW-MO 0.1468313  
Day\_7:y:PW-MO-Day\_3:n:PW-MO 0.9980074  
Day\_1:n:PW+MO-Day\_3:n:PW-MO 0.0000000  
Day\_3:n:PW+MO-Day\_3:n:PW-MO 0.0000000  
Day\_5:n:PW+MO-Day\_3:n:PW-MO 0.0000000  
Day\_7:n:PW+MO-Day\_3:n:PW-MO 0.0000000  
Day\_1:y:PW+MO-Day\_3:n:PW-MO 0.7939449  
Day\_3:y:PW+MO-Day\_3:n:PW-MO 0.0000001  
Day\_5:y:PW+MO-Day\_3:n:PW-MO 0.0000000  
Day\_7:y:PW+MO-Day\_3:n:PW-MO 0.0000000  
Day\_7:n:PW-MO-Day\_5:n:PW-MO 0.5613329  
Day\_1:y:PW-MO-Day\_5:n:PW-MO 0.0139229  
Day\_3:y:PW-MO-Day\_5:n:PW-MO 0.0000002  
Day\_5:y:PW-MO-Day\_5:n:PW-MO 0.0052700  
Day\_7:y:PW-MO-Day\_5:n:PW-MO 0.5426102  
Day\_1:n:PW+MO-Day\_5:n:PW-MO 0.0000015  
Day\_3:n:PW+MO-Day\_5:n:PW-MO 0.0000000  
Day\_5:n:PW+MO-Day\_5:n:PW-MO 0.0000000  
Day\_7:n:PW+MO-Day\_5:n:PW-MO 0.0000000  
Day\_1:y:PW+MO-Day\_5:n:PW-MO 0.9999801  
Day\_3:y:PW+MO-Day\_5:n:PW-MO 0.0000086  
Day\_5:y:PW+MO-Day\_5:n:PW-MO 0.0000002  
Day\_7:y:PW+MO-Day\_5:n:PW-MO 0.0000000  
Day\_1:y:PW-MO-Day\_7:n:PW-MO 0.9899042  
Day\_3:y:PW-MO-Day\_7:n:PW-MO 0.0000000  
Day\_5:y:PW-MO-Day\_7:n:PW-MO 0.0000007  
Day\_7:y:PW-MO-Day\_7:n:PW-MO 0.0005540  
Day\_1:n:PW+MO-Day\_7:n:PW-MO 0.0107673  
Day\_3:n:PW+MO-Day\_7:n:PW-MO 0.0000019  
Day\_5:n:PW+MO-Day\_7:n:PW-MO 0.0000006  
Day\_7:n:PW+MO-Day\_7:n:PW-MO 0.0000000  
Day\_1:y:PW+MO-Day\_7:n:PW-MO 0.9945870  
Day\_3:y:PW+MO-Day\_7:n:PW-MO 0.0440450  
Day\_5:y:PW+MO-Day\_7:n:PW-MO 0.0015888  
Day\_7:y:PW+MO-Day\_7:n:PW-MO 0.0000000  
Day\_3:y:PW-MO-Day\_1:y:PW-MO 0.0000000  
Day\_5:y:PW-MO-Day\_1:y:PW-MO 0.0000000  
Day\_7:y:PW-MO-Day\_1:y:PW-MO 0.0000019  
Day\_1:n:PW+MO-Day\_1:y:PW-MO 0.5002634  
Day\_3:n:PW+MO-Day\_1:y:PW-MO 0.0005697  
Day\_5:n:PW+MO-Day\_1:y:PW-MO 0.0001843  
Day\_7:n:PW+MO-Day\_1:y:PW-MO 0.0000013  
Day\_1:y:PW+MO-Day\_1:y:PW-MO 0.2157143  
Day\_3:y:PW+MO-Day\_1:y:PW-MO 0.8279277  
Day\_5:y:PW+MO-Day\_1:y:PW-MO 0.1650591  
Day\_7:y:PW+MO-Day\_1:y:PW-MO 0.0000002  
Day\_5:y:PW-MO-Day\_3:y:PW-MO 0.3385588  
Day\_7:y:PW-MO-Day\_3:y:PW-MO 0.0019868  
Day\_1:n:PW+MO-Day\_3:y:PW-MO 0.0000000  
Day\_3:n:PW+MO-Day\_3:y:PW-MO 0.0000000  
Day\_5:n:PW+MO-Day\_3:y:PW-MO 0.0000000  
Day\_7:n:PW+MO-Day\_3:y:PW-MO 0.0000000  
Day\_1:y:PW+MO-Day\_3:y:PW-MO 0.0000000  
Day\_3:y:PW+MO-Day\_3:y:PW-MO 0.0000000  
Day\_5:y:PW+MO-Day\_3:y:PW-MO 0.0000000  
Day\_7:y:PW+MO-Day\_3:y:PW-MO 0.0000000  
Day\_7:y:PW-MO-Day\_5:y:PW-MO 0.9434968  
Day\_1:n:PW+MO-Day\_5:y:PW-MO 0.0000000  
Day\_3:n:PW+MO-Day\_5:y:PW-MO 0.0000000  
Day\_5:n:PW+MO-Day\_5:y:PW-MO 0.0000000  
Day\_7:n:PW+MO-Day\_5:y:PW-MO 0.0000000  
Day\_1:y:PW+MO-Day\_5:y:PW-MO 0.0001552  
Day\_3:y:PW+MO-Day\_5:y:PW-MO 0.0000000  
Day\_5:y:PW+MO-Day\_5:y:PW-MO 0.0000000  
Day\_7:y:PW+MO-Day\_5:y:PW-MO 0.0000000  
Day\_1:n:PW+MO-Day\_7:y:PW-MO 0.0000000  
Day\_3:n:PW+MO-Day\_7:y:PW-MO 0.0000000  
Day\_5:n:PW+MO-Day\_7:y:PW-MO 0.0000000  
Day\_7:n:PW+MO-Day\_7:y:PW-MO 0.0000000  
Day\_1:y:PW+MO-Day\_7:y:PW-MO 0.0631035  
Day\_3:y:PW+MO-Day\_7:y:PW-MO 0.0000000  
Day\_5:y:PW+MO-Day\_7:y:PW-MO 0.0000000  
Day\_7:y:PW+MO-Day\_7:y:PW-MO 0.0000000  
Day\_3:n:PW+MO-Day\_1:n:PW+MO 0.6099665  
Day\_5:n:PW+MO-Day\_1:n:PW+MO 0.3802096  
Day\_7:n:PW+MO-Day\_1:n:PW+MO 0.0122628  
Day\_1:y:PW+MO-Day\_1:n:PW+MO 0.0000647  
Day\_3:y:PW+MO-Day\_1:n:PW+MO 1.0000000  
Day\_5:y:PW+MO-Day\_1:n:PW+MO 1.0000000  
Day\_7:y:PW+MO-Day\_1:n:PW+MO 0.0018006  
Day\_5:n:PW+MO-Day\_3:n:PW+MO 1.0000000  
Day\_7:n:PW+MO-Day\_3:n:PW+MO 0.9789155  
Day\_1:y:PW+MO-Day\_3:n:PW+MO 0.0000000  
Day\_3:y:PW+MO-Day\_3:n:PW+MO 0.2866730  
Day\_5:y:PW+MO-Day\_3:n:PW+MO 0.9387984  
Day\_7:y:PW+MO-Day\_3:n:PW+MO 0.7427186  
Day\_7:n:PW+MO-Day\_5:n:PW+MO 0.9984387  
Day\_1:y:PW+MO-Day\_5:n:PW+MO 0.0000000  
Day\_3:y:PW+MO-Day\_5:n:PW+MO 0.1433988  
Day\_5:y:PW+MO-Day\_5:n:PW+MO 0.7925941  
Day\_7:y:PW+MO-Day\_5:n:PW+MO 0.9127621  
Day\_1:y:PW+MO-Day\_7:n:PW+MO 0.0000000  
Day\_3:y:PW+MO-Day\_7:n:PW+MO 0.0026601  
Day\_5:y:PW+MO-Day\_7:n:PW+MO 0.0669760  
Day\_7:y:PW+MO-Day\_7:n:PW+MO 1.0000000  
Day\_3:y:PW+MO-Day\_1:y:PW+MO 0.0003502  
Day\_5:y:PW+MO-Day\_1:y:PW+MO 0.0000077  
Day\_7:y:PW+MO-Day\_1:y:PW+MO 0.0000000  
Day\_5:y:PW+MO-Day\_3:y:PW+MO 0.9999671  
Day\_7:y:PW+MO-Day\_3:y:PW+MO 0.0003506  
Day\_7:y:PW+MO-Day\_5:y:PW+MO 0.0120819

# emmeans and cld  
  
# Compute CLD letters for 'day'  
cld\_day <- emmeans(aov\_sbncos, pairwise ~ day, adjust = "tukey") %>%   
 cld(Letters = letters, reverse = TRUE)

NOTE: Results may be misleading due to involvement in interactions

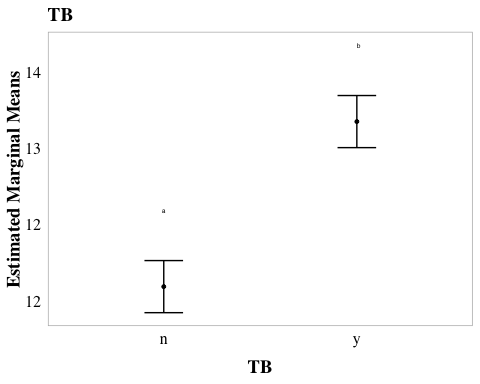
cld\_day\_2b <- ggplot(cld\_day, aes(x = day, y = emmean)) +  
 geom\_point(size = 1) + # Plot the estimated means  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) + # Error bars  
 geom\_text(aes(label = .group), nudge\_y = 0.5, size = 1.75, color = "black") + # Add CLD letters  
 xlab("Day") +  
 ylab("Estimated Marginal Means") +  
 scale\_y\_continuous(labels = scales::label\_number(accuracy = 1))+ # no decimals y axis  
 ggtitle("Day") +  
 scale\_x\_discrete(labels= c("Day\_1" = "1", "Day\_3" = "3", "Day\_5" = "5", "Day\_7" = "7")) +  
 myCustomTheme()+  
 theme(axis.title.y = element\_text(margin = margin(r = 1)))  
cld\_day\_2b



# Compute CLD letters for 'TB'  
cld\_TB <- emmeans(aov\_sbncos, pairwise ~ TB, adjust = "tukey") %>%  
 cld(Letters = letters)

NOTE: Results may be misleading due to involvement in interactions

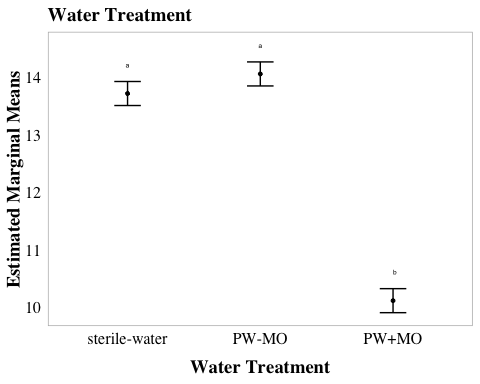
cld\_TB\_2b <- ggplot(cld\_TB, aes(x = TB, y = emmean)) +  
 geom\_point(size = 1) + # Plot the estimated means  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) + # Error bars  
 geom\_text(aes(label = .group), nudge\_y = 0.5, size = 1.75, color = "black") + # Add CLD letters  
 xlab("TB") +  
 ylab("Estimated Marginal Means") +  
 scale\_y\_continuous(labels = scales::label\_number(accuracy = 1))+ # no decimals y axis  
 ggtitle("TB") +  
 myCustomTheme() +  
 theme(axis.title.y = element\_text(margin = margin(r = 1)))  
cld\_TB\_2b



# Compute CLD letters for 'water\_treatment'  
cld\_water\_treatment <- emmeans(aov\_sbncos, pairwise ~ water\_treatment, adjust = "tukey") %>%  
 cld(Letters = letters, reverse = TRUE)

NOTE: Results may be misleading due to involvement in interactions

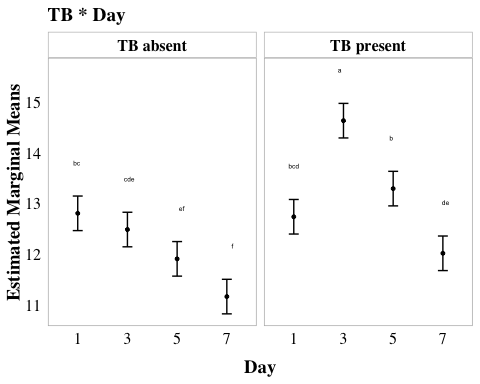
cld\_water\_treatment\_2b <-ggplot(cld\_water\_treatment, aes(x = water\_treatment, y = emmean)) +  
 geom\_point(size = 1) + # Plot the estimated means  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) + # Error bars  
 geom\_text(aes(label = .group), nudge\_y = 0.5, size = 1.75, color = "black") + # Add CLD letters  
 xlab("Water Treatment") +  
 ylab("Estimated Marginal Means") +  
 scale\_y\_continuous(labels = scales::label\_number(accuracy = 1))+ # no decimals y axis  
 ggtitle("Water Treatment") +  
 myCustomTheme()+  
 theme(axis.title.y = element\_text(margin = margin(r = 1)))  
cld\_water\_treatment\_2b



# Compute CLD letters for 'TB \* day'  
cld\_day\_TB <- emmeans(aov\_sbncos, pairwise ~ TB \* day, adjust = "tukey") %>%  
 cld(Letters = letters, reverse = TRUE)

NOTE: Results may be misleading due to involvement in interactions

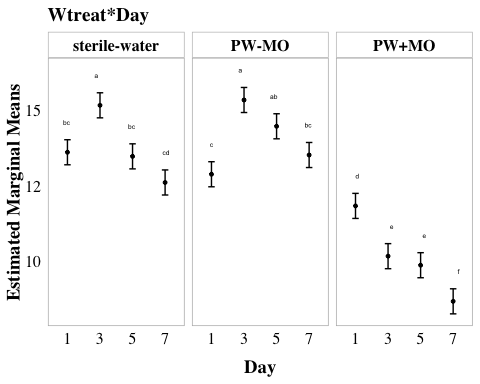
tb\_labels <- c("n" = "TB absent", "y" = "TB present")  
# Create the plot with custom labels for 'TB'  
cld\_tb\_day\_int\_2b <- ggplot(cld\_day\_TB, aes(x = factor(day), y = emmean)) +  
 geom\_point(size = 1) + # Plot the estimated means  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) + # Error bars  
 geom\_text(aes(label = .group), nudge\_y = 1, size = 1.75, color = "black") + # Add CLD letters  
 facet\_wrap(~ TB, labeller = as\_labeller(tb\_labels)) + # Facet by TB with custom labels  
 xlab("Day") +  
 ylab("Estimated Marginal Means") +  
 scale\_y\_continuous(labels = scales::label\_number(accuracy = 1))+ # no decimals y axis  
 ggtitle("TB \* Day") +  
 scale\_x\_discrete(labels= c("Day\_1" = "1", "Day\_3" = "3", "Day\_5" = "5", "Day\_7" = "7")) +  
 myCustomTheme()+  
 theme(axis.title.y = element\_text(margin = margin(r = 1)))  
cld\_tb\_day\_int\_2b



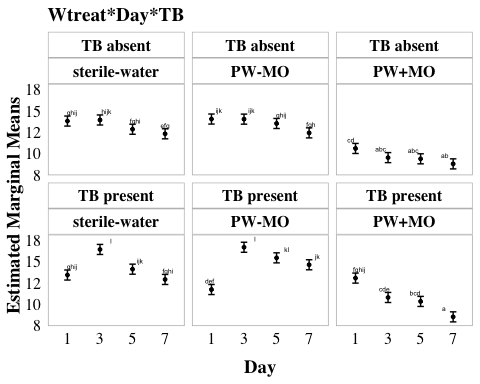
# Compute CLD letters for 'water\_treatment \* day'  
cld\_water\_treatment\_day <- emmeans(aov\_sbncos, pairwise ~ water\_treatment \* day, adjust = "tukey") %>%  
 cld(Letters = letters, reverse = TRUE)

NOTE: Results may be misleading due to involvement in interactions

cld\_watertreat\_day\_int\_2b <- ggplot(cld\_water\_treatment\_day, aes(x = factor(day), y = emmean)) +  
 geom\_point(size = 1) + # Plot the estimated means  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) + # Error bars  
 geom\_text(aes(label = .group), nudge\_y = 1, size = 1.75, color = "black") + # Add CLD letters  
 facet\_wrap(~ water\_treatment) + # Facet by water\_treatment  
 xlab("Day") +  
 ylab("Estimated Marginal Means") +  
 scale\_y\_continuous(labels = scales::label\_number(accuracy = 1))+ # no decimals y axis  
 ggtitle("Wtreat\*Day") +  
 scale\_x\_discrete(labels= c("Day\_1" = "1", "Day\_3" = "3", "Day\_5" = "5", "Day\_7" = "7")) +  
 myCustomTheme()+  
 theme(axis.title.y = element\_text(margin = margin(r = 1)))  
cld\_watertreat\_day\_int\_2b



# third order...prepare for chaos  
# Compute CLD letters for 'water\_treatment \* day'  
cld\_water\_thirdorder <- emmeans(aov\_sbncos, pairwise ~ water\_treatment \* day \* TB, adjust = "tukey") %>%  
 cld(Letters = letters)  
tb\_labels <- c("n" = "TB absent", "y" = "TB present")  
cld\_water\_thirdorder\_2b <- ggplot(cld\_water\_thirdorder, aes(x = factor(day), y = emmean)) +  
 geom\_point(size = 1) + # Plot the estimated means  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) + # Error bars  
 geom\_text(aes(label = .group), nudge\_y = 1, size = 1.75, color = "black") + # Add CLD letters  
 facet\_wrap(TB ~ water\_treatment, labeller = labeller(TB = tb\_labels)) + # Facet by water\_treatment with custom labels for TB  
 xlab("Day") +  
 ylab("Estimated Marginal Means") +  
 scale\_y\_continuous(labels = scales::label\_number(accuracy = 1))+ # no decimals y axis  
 ggtitle("Wtreat\*Day\*TB") +  
 scale\_x\_discrete(labels= c("Day\_1" = "1", "Day\_3" = "3", "Day\_5" = "5", "Day\_7" = "7")) +  
 myCustomTheme()+  
 theme(axis.title.y = element\_text(margin = margin(r = 1)))  
cld\_water\_thirdorder\_2b



# get the stats for each comparison  
ph\_2b\_day <- emmeans(aov\_sbncos, pairwise ~ day, adjust = "tukey")$contrasts

NOTE: Results may be misleading due to involvement in interactions

ph\_2b\_TB <- emmeans(aov\_sbncos, pairwise ~ TB, adjust = "tukey")$contrasts

NOTE: Results may be misleading due to involvement in interactions

ph\_2b\_water\_treatment <- emmeans(aov\_sbncos, pairwise ~ water\_treatment, adjust = "tukey")$contrasts

NOTE: Results may be misleading due to involvement in interactions

ph\_2b\_day\_TB <- emmeans(aov\_sbncos, pairwise ~ TB \* day, adjust = "tukey")$contrasts

NOTE: Results may be misleading due to involvement in interactions

ph\_2b\_water\_treatment\_day <- emmeans(aov\_sbncos, pairwise ~ water\_treatment \* day, adjust = "tukey")$contrasts

NOTE: Results may be misleading due to involvement in interactions

ph\_2b\_water\_thirdorder <- emmeans(aov\_sbncos, pairwise ~ water\_treatment \* day \* TB, adjust = "tukey")$contrasts

## Reviewer request: GLM with log link function on untransformed data

## GLM untransformed Bd ~ day\*TB\*water\_treatment

## Try Poisson  
# round the data in new column for a poisson family  
pw\_noday0$adh\_plus\_sup\_rounded <- round(pw\_noday0$adh\_plus\_sup)  
  
# normal distribution, should be relatively the same as the anova  
mod\_pois\_glm <- glm(adh\_plus\_sup\_rounded ~ day \* TB \* water\_treatment,  
 data = pw\_noday0,  
 family = poisson(link = "log"))  
  
summary(mod\_pois\_glm) # ok this is sketchy, I dont think it converged... look at those teeny SE and everythign being highly significant

Call:  
glm(formula = adh\_plus\_sup\_rounded ~ day \* TB \* water\_treatment,   
 family = poisson(link = "log"), data = pw\_noday0)  
  
Coefficients:  
 Estimate Std. Error z value Pr(>|z|)   
(Intercept) 13.8296932 0.0005733 24124.20 <2e-16 \*\*\*  
dayDay\_3 0.0995686 0.0007913 125.83 <2e-16 \*\*\*  
dayDay\_5 -0.9870049 0.0011002 -897.11 <2e-16 \*\*\*  
dayDay\_7 -1.5220964 0.0013544 -1123.81 <2e-16 \*\*\*  
TBy -0.2514919 0.0008667 -290.16 <2e-16 \*\*\*  
water\_treatmentPW-MO 0.2095173 0.0007715 271.58 <2e-16 \*\*\*  
water\_treatmentPW+MO -2.7859610 0.0023786 -1171.27 <2e-16 \*\*\*  
dayDay\_3:TBy 2.7528822 0.0010359 2657.43 <2e-16 \*\*\*  
dayDay\_5:TBy 1.5441638 0.0013694 1127.66 <2e-16 \*\*\*  
dayDay\_7:TBy 0.8557003 0.0017550 487.59 <2e-16 \*\*\*  
dayDay\_3:water\_treatmentPW-MO -0.1111153 0.0010781 -103.07 <2e-16 \*\*\*  
dayDay\_5:water\_treatmentPW-MO 0.4656453 0.0013878 335.54 <2e-16 \*\*\*  
dayDay\_7:water\_treatmentPW-MO -0.0968754 0.0018564 -52.18 <2e-16 \*\*\*  
dayDay\_3:water\_treatmentPW+MO -1.5892525 0.0054399 -292.14 <2e-16 \*\*\*  
dayDay\_5:water\_treatmentPW+MO -0.6521642 0.0058300 -111.86 <2e-16 \*\*\*  
dayDay\_7:water\_treatmentPW+MO -0.6062931 0.0072065 -84.13 <2e-16 \*\*\*  
TBy:water\_treatmentPW-MO -1.7386683 0.0017227 -1009.25 <2e-16 \*\*\*  
TBy:water\_treatmentPW+MO 2.2768805 0.0026045 874.21 <2e-16 \*\*\*  
dayDay\_3:TBy:water\_treatmentPW-MO 1.9044295 0.0018916 1006.80 <2e-16 \*\*\*  
dayDay\_5:TBy:water\_treatmentPW-MO 2.3936011 0.0021458 1115.46 <2e-16 \*\*\*  
dayDay\_7:TBy:water\_treatmentPW-MO 3.5475298 0.0026004 1364.20 <2e-16 \*\*\*  
dayDay\_3:TBy:water\_treatmentPW+MO -3.5314723 0.0061268 -576.40 <2e-16 \*\*\*  
dayDay\_5:TBy:water\_treatmentPW+MO -2.4985473 0.0066905 -373.45 <2e-16 \*\*\*  
dayDay\_7:TBy:water\_treatmentPW+MO -3.1795138 0.0106875 -297.50 <2e-16 \*\*\*  
---  
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
  
(Dispersion parameter for poisson family taken to be 1)  
  
 Null deviance: 373695575 on 71 degrees of freedom  
Residual deviance: 5506365 on 48 degrees of freedom  
AIC: 5507455  
  
Number of Fisher Scoring iterations: 5

## Try gaussian  
mod\_gaus\_glm <- glm(adh\_plus\_sup ~ day \* TB \* water\_treatment,  
 data = pw\_noday0,  
 family = gaussian(link = "log"))  
  
summary(mod\_gaus\_glm) # looks more reasonable than pois

Call:  
glm(formula = adh\_plus\_sup ~ day \* TB \* water\_treatment, family = gaussian(link = "log"),   
 data = pw\_noday0)  
  
Coefficients:  
 Estimate Std. Error t value Pr(>|t|)   
(Intercept) 13.82969 0.42888 32.246 < 2e-16 \*\*\*  
dayDay\_3 0.09957 0.57850 0.172 0.86407   
dayDay\_5 -0.98700 1.22809 -0.804 0.42554   
dayDay\_7 -1.52210 2.01132 -0.757 0.45289   
TBy -0.25149 0.69865 -0.360 0.72045   
water\_treatmentPW-MO 0.20952 0.55219 0.379 0.70604   
water\_treatmentPW+MO -2.78596 6.96765 -0.400 0.69105   
dayDay\_3:TBy 2.75288 0.79991 3.442 0.00121 \*\*   
dayDay\_5:TBy 1.54416 1.38282 1.117 0.26969   
dayDay\_7:TBy 0.85570 2.34582 0.365 0.71688   
dayDay\_3:water\_treatmentPW-MO -0.11112 0.76121 -0.146 0.88455   
dayDay\_5:water\_treatmentPW-MO 0.46565 1.40442 0.332 0.74167   
dayDay\_7:water\_treatmentPW-MO -0.09688 2.69239 -0.036 0.97145   
dayDay\_3:water\_treatmentPW+MO -1.58925 31.62750 -0.050 0.96013   
dayDay\_5:water\_treatmentPW+MO -0.65216 36.51132 -0.018 0.98582   
dayDay\_7:water\_treatmentPW+MO -0.60629 58.87376 -0.010 0.99183   
TBy:water\_treatmentPW-MO -1.73867 2.66183 -0.653 0.51675   
TBy:water\_treatmentPW+MO 2.27688 7.04942 0.323 0.74811   
dayDay\_3:TBy:water\_treatmentPW-MO 1.90443 2.71320 0.702 0.48612   
dayDay\_5:TBy:water\_treatmentPW-MO 2.39360 2.97650 0.804 0.42527   
dayDay\_7:TBy:water\_treatmentPW-MO 3.54753 3.89966 0.910 0.36753   
dayDay\_3:TBy:water\_treatmentPW+MO -3.53147 32.86427 -0.107 0.91487   
dayDay\_5:TBy:water\_treatmentPW+MO -2.49855 38.53562 -0.065 0.94857   
dayDay\_7:TBy:water\_treatmentPW+MO -3.17951 98.33131 -0.032 0.97434   
---  
Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
  
(Dispersion parameter for gaussian family taken to be 5.67697e+11)  
  
 Null deviance: 1.3693e+15 on 71 degrees of freedom  
Residual deviance: 2.7249e+13 on 48 degrees of freedom  
AIC: 2173.8  
  
Number of Fisher Scoring iterations: 5

Comparisons using gaussian glm

# all comparisons  
em <- emmeans(mod\_gaus\_glm, ~ day \* TB \* water\_treatment)  
# Perform the Tukey test for pairwise comparisons  
pairwise\_comparisons <- contrast(em, method = "pairwise", adjust = "tukey")  
summary(pairwise\_comparisons)

contrast estimate SE df t.ratio  
 (Day\_1 n sterile-water) - (Day\_3 n sterile-water) -0.0996 0.5785 48 -0.172  
 (Day\_1 n sterile-water) - (Day\_5 n sterile-water) 0.9870 1.2281 48 0.804  
 (Day\_1 n sterile-water) - (Day\_7 n sterile-water) 1.5221 2.0113 48 0.757  
 (Day\_1 n sterile-water) - (Day\_1 y sterile-water) 0.2515 0.6986 48 0.360  
 (Day\_1 n sterile-water) - (Day\_3 y sterile-water) -2.6010 0.4301 48 -6.048  
 (Day\_1 n sterile-water) - (Day\_5 y sterile-water) -0.3057 0.5327 48 -0.574  
 (Day\_1 n sterile-water) - (Day\_7 y sterile-water) 0.9179 1.1564 48 0.794  
 (Day\_1 n sterile-water) - (Day\_1 n PW-MO) -0.2095 0.5522 48 -0.379  
 (Day\_1 n sterile-water) - (Day\_3 n PW-MO) -0.1980 0.5547 48 -0.357  
 (Day\_1 n sterile-water) - (Day\_5 n PW-MO) 0.3118 0.7260 48 0.430  
 (Day\_1 n sterile-water) - (Day\_7 n PW-MO) 1.4095 1.8074 48 0.780  
 (Day\_1 n sterile-water) - (Day\_1 y PW-MO) 1.7806 2.5807 48 0.690  
 (Day\_1 n sterile-water) - (Day\_3 y PW-MO) -2.8651 0.4296 48 -6.670  
 (Day\_1 n sterile-water) - (Day\_5 y PW-MO) -1.6358 0.4369 48 -3.744  
 (Day\_1 n sterile-water) - (Day\_7 y PW-MO) -1.0036 0.4568 48 -2.197  
 (Day\_1 n sterile-water) - (Day\_1 n PW+MO) 2.7860 6.9676 48 0.400  
 (Day\_1 n sterile-water) - (Day\_3 n PW+MO) 4.2756 30.8510 48 0.139  
 (Day\_1 n sterile-water) - (Day\_5 n PW+MO) 4.4251 35.8244 48 0.124  
 (Day\_1 n sterile-water) - (Day\_7 n PW+MO) 4.9143 58.4285 48 0.084  
 (Day\_1 n sterile-water) - (Day\_1 y PW+MO) 0.7606 1.0129 48 0.751  
 (Day\_1 n sterile-water) - (Day\_3 y PW+MO) 3.0288 8.8768 48 0.341  
 (Day\_1 n sterile-water) - (Day\_5 y PW+MO) 3.3541 12.2823 48 0.273  
 (Day\_1 n sterile-water) - (Day\_7 y PW+MO) 5.2128 78.7452 48 0.066  
 (Day\_3 n sterile-water) - (Day\_5 n sterile-water) 1.0866 1.2145 48 0.895  
 (Day\_3 n sterile-water) - (Day\_7 n sterile-water) 1.6217 2.0030 48 0.810  
 (Day\_3 n sterile-water) - (Day\_1 y sterile-water) 0.3511 0.6745 48 0.521  
 (Day\_3 n sterile-water) - (Day\_3 y sterile-water) -2.5014 0.3895 48 -6.421  
 (Day\_3 n sterile-water) - (Day\_5 y sterile-water) -0.2061 0.5005 48 -0.412  
 (Day\_3 n sterile-water) - (Day\_7 y sterile-water) 1.0175 1.1419 48 0.891  
 (Day\_3 n sterile-water) - (Day\_1 n PW-MO) -0.1099 0.5212 48 -0.211  
 (Day\_3 n sterile-water) - (Day\_3 n PW-MO) -0.0984 0.5240 48 -0.188  
 (Day\_3 n sterile-water) - (Day\_5 n PW-MO) 0.4114 0.7028 48 0.585  
 (Day\_3 n sterile-water) - (Day\_7 n PW-MO) 1.5090 1.7981 48 0.839  
 (Day\_3 n sterile-water) - (Day\_1 y PW-MO) 1.8802 2.5743 48 0.730  
 (Day\_3 n sterile-water) - (Day\_3 y PW-MO) -2.7656 0.3890 48 -7.109  
 (Day\_3 n sterile-water) - (Day\_5 y PW-MO) -1.5362 0.3971 48 -3.868  
 (Day\_3 n sterile-water) - (Day\_7 y PW-MO) -0.9040 0.4189 48 -2.158  
 (Day\_3 n sterile-water) - (Day\_1 n PW+MO) 2.8855 6.9653 48 0.414  
 (Day\_3 n sterile-water) - (Day\_3 n PW+MO) 4.3752 30.8505 48 0.142  
 (Day\_3 n sterile-water) - (Day\_5 n PW+MO) 4.5247 35.8239 48 0.126  
 (Day\_3 n sterile-water) - (Day\_7 n PW+MO) 5.0139 58.4282 48 0.086  
 (Day\_3 n sterile-water) - (Day\_1 y PW+MO) 0.8601 0.9963 48 0.863  
 (Day\_3 n sterile-water) - (Day\_3 y PW+MO) 3.1284 8.8749 48 0.352  
 (Day\_3 n sterile-water) - (Day\_5 y PW+MO) 3.4537 12.2810 48 0.281  
 (Day\_3 n sterile-water) - (Day\_7 y PW+MO) 5.3123 78.7450 48 0.067  
 (Day\_5 n sterile-water) - (Day\_7 n sterile-water) 0.5351 2.2772 48 0.235  
 (Day\_5 n sterile-water) - (Day\_1 y sterile-water) -0.7355 1.2761 48 -0.576  
 (Day\_5 n sterile-water) - (Day\_3 y sterile-water) -3.5880 1.1512 48 -3.117  
 (Day\_5 n sterile-water) - (Day\_5 y sterile-water) -1.2927 1.1933 48 -1.083  
 (Day\_5 n sterile-water) - (Day\_7 y sterile-water) -0.0691 1.5740 48 -0.044  
 (Day\_5 n sterile-water) - (Day\_1 n PW-MO) -1.1965 1.2022 48 -0.995  
 (Day\_5 n sterile-water) - (Day\_3 n PW-MO) -1.1850 1.2034 48 -0.985  
 (Day\_5 n sterile-water) - (Day\_5 n PW-MO) -0.6752 1.2913 48 -0.523  
 (Day\_5 n sterile-water) - (Day\_7 n PW-MO) 0.4224 2.0993 48 0.201  
 (Day\_5 n sterile-water) - (Day\_1 y PW-MO) 0.7936 2.7929 48 0.284  
 (Day\_5 n sterile-water) - (Day\_3 y PW-MO) -3.8521 1.1510 48 -3.347  
 (Day\_5 n sterile-water) - (Day\_5 y PW-MO) -2.6228 1.1538 48 -2.273  
 (Day\_5 n sterile-water) - (Day\_7 y PW-MO) -1.9906 1.1615 48 -1.714  
 (Day\_5 n sterile-water) - (Day\_1 n PW+MO) 1.7990 7.0490 48 0.255  
 (Day\_5 n sterile-water) - (Day\_3 n PW+MO) 3.2886 30.8695 48 0.107  
 (Day\_5 n sterile-water) - (Day\_5 n PW+MO) 3.4381 35.8403 48 0.096  
 (Day\_5 n sterile-water) - (Day\_7 n PW+MO) 3.9273 58.4383 48 0.067  
 (Day\_5 n sterile-water) - (Day\_1 y PW+MO) -0.2264 1.4718 48 -0.154  
 (Day\_5 n sterile-water) - (Day\_3 y PW+MO) 2.0418 8.9408 48 0.228  
 (Day\_5 n sterile-water) - (Day\_5 y PW+MO) 2.3671 12.3287 48 0.192  
 (Day\_5 n sterile-water) - (Day\_7 y PW+MO) 4.2258 78.7525 48 0.054  
 (Day\_7 n sterile-water) - (Day\_1 y sterile-water) -1.2706 2.0410 48 -0.623  
 (Day\_7 n sterile-water) - (Day\_3 y sterile-water) -4.1231 1.9653 48 -2.098  
 (Day\_7 n sterile-water) - (Day\_5 y sterile-water) -1.8278 1.9903 48 -0.918  
 (Day\_7 n sterile-water) - (Day\_7 y sterile-water) -0.6042 2.2394 48 -0.270  
 (Day\_7 n sterile-water) - (Day\_1 n PW-MO) -1.7316 1.9956 48 -0.868  
 (Day\_7 n sterile-water) - (Day\_3 n PW-MO) -1.7201 1.9963 48 -0.862  
 (Day\_7 n sterile-water) - (Day\_5 n PW-MO) -1.2103 2.0505 48 -0.590  
 (Day\_7 n sterile-water) - (Day\_7 n PW-MO) -0.1126 2.6351 48 -0.043  
 (Day\_7 n sterile-water) - (Day\_1 y PW-MO) 0.2585 3.2152 48 0.080  
 (Day\_7 n sterile-water) - (Day\_3 y PW-MO) -4.3872 1.9652 48 -2.232  
 (Day\_7 n sterile-water) - (Day\_5 y PW-MO) -3.1579 1.9668 48 -1.606  
 (Day\_7 n sterile-water) - (Day\_7 y PW-MO) -2.5257 1.9713 48 -1.281  
 (Day\_7 n sterile-water) - (Day\_1 n PW+MO) 1.2639 7.2267 48 0.175  
 (Day\_7 n sterile-water) - (Day\_3 n PW+MO) 2.7535 30.9105 48 0.089  
 (Day\_7 n sterile-water) - (Day\_5 n PW+MO) 2.9030 35.8757 48 0.081  
 (Day\_7 n sterile-water) - (Day\_7 n PW+MO) 3.3923 58.4600 48 0.058  
 (Day\_7 n sterile-water) - (Day\_1 y PW+MO) -0.7615 2.1687 48 -0.351  
 (Day\_7 n sterile-water) - (Day\_3 y PW+MO) 1.5068 9.0816 48 0.166  
 (Day\_7 n sterile-water) - (Day\_5 y PW+MO) 1.8320 12.4312 48 0.147  
 (Day\_7 n sterile-water) - (Day\_7 y PW+MO) 3.6907 78.7686 48 0.047  
 (Day\_1 y sterile-water) - (Day\_3 y sterile-water) -2.8525 0.5524 48 -5.163  
 (Day\_1 y sterile-water) - (Day\_5 y sterile-water) -0.5572 0.6356 48 -0.877  
 (Day\_1 y sterile-water) - (Day\_7 y sterile-water) 0.6664 1.2073 48 0.552  
 (Day\_1 y sterile-water) - (Day\_1 n PW-MO) -0.4610 0.6520 48 -0.707  
 (Day\_1 y sterile-water) - (Day\_3 n PW-MO) -0.4495 0.6542 48 -0.687  
 (Day\_1 y sterile-water) - (Day\_5 n PW-MO) 0.0604 0.8046 48 0.075  
 (Day\_1 y sterile-water) - (Day\_7 n PW-MO) 1.1580 1.8403 48 0.629  
 (Day\_1 y sterile-water) - (Day\_1 y PW-MO) 1.5292 2.6039 48 0.587  
 (Day\_1 y sterile-water) - (Day\_3 y PW-MO) -3.1166 0.5521 48 -5.645  
 (Day\_1 y sterile-water) - (Day\_5 y PW-MO) -1.8873 0.5578 48 -3.383  
 (Day\_1 y sterile-water) - (Day\_7 y PW-MO) -1.2551 0.5735 48 -2.189  
 (Day\_1 y sterile-water) - (Day\_1 n PW+MO) 2.5345 6.9763 48 0.363  
 (Day\_1 y sterile-water) - (Day\_3 n PW+MO) 4.0242 30.8529 48 0.130  
 (Day\_1 y sterile-water) - (Day\_5 n PW+MO) 4.1736 35.8261 48 0.116  
 (Day\_1 y sterile-water) - (Day\_7 n PW+MO) 4.6629 58.4296 48 0.080  
 (Day\_1 y sterile-water) - (Day\_1 y PW+MO) 0.5091 1.0706 48 0.476  
 (Day\_1 y sterile-water) - (Day\_3 y PW+MO) 2.7774 8.8836 48 0.313  
 (Day\_1 y sterile-water) - (Day\_5 y PW+MO) 3.1026 12.2872 48 0.253  
 (Day\_1 y sterile-water) - (Day\_7 y PW+MO) 4.9613 78.7460 48 0.063  
 (Day\_3 y sterile-water) - (Day\_5 y sterile-water) 2.2953 0.3175 48 7.229  
 (Day\_3 y sterile-water) - (Day\_7 y sterile-water) 3.5188 1.0744 48 3.275  
 (Day\_3 y sterile-water) - (Day\_1 n PW-MO) 2.3914 0.3493 48 6.847  
 (Day\_3 y sterile-water) - (Day\_3 n PW-MO) 2.4030 0.3533 48 6.802  
 (Day\_3 y sterile-water) - (Day\_5 n PW-MO) 2.9128 0.5867 48 4.965  
 (Day\_3 y sterile-water) - (Day\_7 n PW-MO) 4.0104 1.7560 48 2.284  
 (Day\_3 y sterile-water) - (Day\_1 y PW-MO) 4.3816 2.5450 48 1.722  
 (Day\_3 y sterile-water) - (Day\_3 y PW-MO) -0.2642 0.0401 48 -6.584  
 (Day\_3 y sterile-water) - (Day\_5 y PW-MO) 0.9652 0.0894 48 10.796  
 (Day\_3 y sterile-water) - (Day\_7 y PW-MO) 1.5973 0.1604 48 9.959  
 (Day\_3 y sterile-water) - (Day\_1 n PW+MO) 5.3869 6.9545 48 0.775  
 (Day\_3 y sterile-water) - (Day\_3 n PW+MO) 6.8766 30.8480 48 0.223  
 (Day\_3 y sterile-water) - (Day\_5 n PW+MO) 7.0261 35.8218 48 0.196  
 (Day\_3 y sterile-water) - (Day\_7 n PW+MO) 7.5153 58.4270 48 0.129  
 (Day\_3 y sterile-water) - (Day\_1 y PW+MO) 3.3615 0.9182 48 3.661  
 (Day\_3 y sterile-water) - (Day\_3 y PW+MO) 5.6298 8.8665 48 0.635  
 (Day\_3 y sterile-water) - (Day\_5 y PW+MO) 5.9551 12.2749 48 0.485  
 (Day\_3 y sterile-water) - (Day\_7 y PW+MO) 7.8137 78.7441 48 0.099  
 (Day\_5 y sterile-water) - (Day\_7 y sterile-water) 1.2236 1.1194 48 1.093  
 (Day\_5 y sterile-water) - (Day\_1 n PW-MO) 0.0961 0.4699 48 0.205  
 (Day\_5 y sterile-water) - (Day\_3 n PW-MO) 0.1077 0.4729 48 0.228  
 (Day\_5 y sterile-water) - (Day\_5 n PW-MO) 0.6175 0.6656 48 0.928  
 (Day\_5 y sterile-water) - (Day\_7 n PW-MO) 1.7151 1.7839 48 0.961  
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 (Day\_5 y sterile-water) - (Day\_1 n PW+MO) 3.0916 6.9616 48 0.444  
 (Day\_5 y sterile-water) - (Day\_3 n PW+MO) 4.5813 30.8496 48 0.149  
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 (Day\_5 y sterile-water) - (Day\_3 y PW+MO) 3.3345 8.8721 48 0.376  
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 (Day\_7 y sterile-water) - (Day\_1 n PW-MO) -1.1274 1.1288 48 -0.999  
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 (Day\_1 n PW-MO) - (Day\_3 n PW-MO) 0.0115 0.4948 48 0.023  
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 (Day\_1 n PW-MO) - (Day\_3 n PW+MO) 4.4852 30.8500 48 0.145  
 (Day\_1 n PW-MO) - (Day\_5 n PW+MO) 4.6346 35.8235 48 0.129  
 (Day\_1 n PW-MO) - (Day\_7 n PW+MO) 5.1239 58.4280 48 0.088  
 (Day\_1 n PW-MO) - (Day\_1 y PW+MO) 0.9701 0.9813 48 0.989  
 (Day\_1 n PW-MO) - (Day\_3 y PW+MO) 3.2384 8.8733 48 0.365  
 (Day\_1 n PW-MO) - (Day\_5 y PW+MO) 3.5636 12.2798 48 0.290  
 (Day\_1 n PW-MO) - (Day\_7 y PW+MO) 5.4223 78.7448 48 0.069  
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 (Day\_3 n PW-MO) - (Day\_7 n PW-MO) 1.6074 1.7906 48 0.898  
 (Day\_3 n PW-MO) - (Day\_1 y PW-MO) 1.9786 2.5690 48 0.770  
 (Day\_3 n PW-MO) - (Day\_3 y PW-MO) -2.6672 0.3527 48 -7.562  
 (Day\_3 n PW-MO) - (Day\_5 y PW-MO) -1.4378 0.3616 48 -3.976  
 (Day\_3 n PW-MO) - (Day\_7 y PW-MO) -0.8056 0.3854 48 -2.091  
 (Day\_3 n PW-MO) - (Day\_1 n PW+MO) 2.9839 6.9633 48 0.429  
 (Day\_3 n PW-MO) - (Day\_3 n PW+MO) 4.4736 30.8500 48 0.145  
 (Day\_3 n PW-MO) - (Day\_5 n PW+MO) 4.6231 35.8236 48 0.129  
 (Day\_3 n PW-MO) - (Day\_7 n PW+MO) 5.1123 58.4280 48 0.087  
 (Day\_3 n PW-MO) - (Day\_1 y PW+MO) 0.9585 0.9827 48 0.975  
 (Day\_3 n PW-MO) - (Day\_3 y PW+MO) 3.2268 8.8734 48 0.364  
 (Day\_3 n PW-MO) - (Day\_5 y PW+MO) 3.5521 12.2799 48 0.289  
 (Day\_3 n PW-MO) - (Day\_7 y PW+MO) 5.4107 78.7448 48 0.069  
 (Day\_5 n PW-MO) - (Day\_7 n PW-MO) 1.0976 1.8509 48 0.593  
 (Day\_5 n PW-MO) - (Day\_1 y PW-MO) 1.4688 2.6114 48 0.562  
 (Day\_5 n PW-MO) - (Day\_3 y PW-MO) -3.1770 0.5863 48 -5.418  
 (Day\_5 n PW-MO) - (Day\_5 y PW-MO) -1.9476 0.5917 48 -3.291  
 (Day\_5 n PW-MO) - (Day\_7 y PW-MO) -1.3155 0.6066 48 -2.169  
 (Day\_5 n PW-MO) - (Day\_1 n PW+MO) 2.4741 6.9791 48 0.355  
 (Day\_5 n PW-MO) - (Day\_3 n PW+MO) 3.9638 30.8536 48 0.128  
 (Day\_5 n PW-MO) - (Day\_5 n PW+MO) 4.1133 35.8266 48 0.115  
 (Day\_5 n PW-MO) - (Day\_7 n PW+MO) 4.6025 58.4299 48 0.079  
 (Day\_5 n PW-MO) - (Day\_1 y PW+MO) 0.4487 1.0887 48 0.412  
 (Day\_5 n PW-MO) - (Day\_3 y PW+MO) 2.7170 8.8858 48 0.306  
 (Day\_5 n PW-MO) - (Day\_5 y PW+MO) 3.0423 12.2888 48 0.248  
 (Day\_5 n PW-MO) - (Day\_7 y PW+MO) 4.9009 78.7462 48 0.062  
 (Day\_7 n PW-MO) - (Day\_1 y PW-MO) 0.3712 3.0917 48 0.120  
 (Day\_7 n PW-MO) - (Day\_3 y PW-MO) -4.2746 1.7559 48 -2.434  
 (Day\_7 n PW-MO) - (Day\_5 y PW-MO) -3.0452 1.7577 48 -1.732  
 (Day\_7 n PW-MO) - (Day\_7 y PW-MO) -2.4131 1.7628 48 -1.369  
 (Day\_7 n PW-MO) - (Day\_1 n PW+MO) 1.3765 7.1726 48 0.192  
 (Day\_7 n PW-MO) - (Day\_3 n PW+MO) 2.8662 30.8979 48 0.093  
 (Day\_7 n PW-MO) - (Day\_5 n PW+MO) 3.0157 35.8648 48 0.084  
 (Day\_7 n PW-MO) - (Day\_7 n PW+MO) 3.5049 58.4533 48 0.060  
 (Day\_7 n PW-MO) - (Day\_1 y PW+MO) -0.6489 1.9810 48 -0.328  
 (Day\_7 n PW-MO) - (Day\_3 y PW+MO) 1.6194 9.0386 48 0.179  
 (Day\_7 n PW-MO) - (Day\_5 y PW+MO) 1.9447 12.3998 48 0.157  
 (Day\_7 n PW-MO) - (Day\_7 y PW+MO) 3.8033 78.7636 48 0.048  
 (Day\_1 y PW-MO) - (Day\_3 y PW-MO) -4.6458 2.5450 48 -1.825  
 (Day\_1 y PW-MO) - (Day\_5 y PW-MO) -3.4164 2.5462 48 -1.342  
 (Day\_1 y PW-MO) - (Day\_7 y PW-MO) -2.7843 2.5497 48 -1.092  
 (Day\_1 y PW-MO) - (Day\_1 n PW+MO) 1.0053 7.4054 48 0.136  
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 (Day\_1 y PW-MO) - (Day\_7 n PW+MO) 3.1337 58.4824 48 0.054  
 (Day\_1 y PW-MO) - (Day\_1 y PW+MO) -1.0201 2.7052 48 -0.377  
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 (Day\_1 y PW-MO) - (Day\_7 y PW+MO) 3.4321 78.7852 48 0.044  
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 (Day\_3 y PW-MO) - (Day\_1 n PW+MO) 5.6511 6.9545 48 0.813  
 (Day\_3 y PW-MO) - (Day\_3 n PW+MO) 7.1408 30.8480 48 0.231  
 (Day\_3 y PW-MO) - (Day\_5 n PW+MO) 7.2903 35.8218 48 0.204  
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 (Day\_3 y PW-MO) - (Day\_1 y PW+MO) 3.6257 0.9179 48 3.950  
 (Day\_3 y PW-MO) - (Day\_3 y PW+MO) 5.8940 8.8665 48 0.665  
 (Day\_3 y PW-MO) - (Day\_5 y PW+MO) 6.2192 12.2749 48 0.507  
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 (Day\_5 y PW-MO) - (Day\_7 y PW-MO) 0.6321 0.1780 48 3.551  
 (Day\_5 y PW-MO) - (Day\_1 n PW+MO) 4.4217 6.9549 48 0.636  
 (Day\_5 y PW-MO) - (Day\_3 n PW+MO) 5.9114 30.8481 48 0.192  
 (Day\_5 y PW-MO) - (Day\_5 n PW+MO) 6.0609 35.8219 48 0.169  
 (Day\_5 y PW-MO) - (Day\_7 n PW+MO) 6.5501 58.4270 48 0.112  
 (Day\_5 y PW-MO) - (Day\_1 y PW+MO) 2.3963 0.9214 48 2.601  
 (Day\_5 y PW-MO) - (Day\_3 y PW+MO) 4.6646 8.8668 48 0.526  
 (Day\_5 y PW-MO) - (Day\_5 y PW+MO) 4.9899 12.2751 48 0.407  
 (Day\_5 y PW-MO) - (Day\_7 y PW+MO) 6.8485 78.7441 48 0.087  
 (Day\_7 y PW-MO) - (Day\_1 n PW+MO) 3.7896 6.9562 48 0.545  
 (Day\_7 y PW-MO) - (Day\_3 n PW+MO) 5.2793 30.8484 48 0.171  
 (Day\_7 y PW-MO) - (Day\_5 n PW+MO) 5.4287 35.8222 48 0.152  
 (Day\_7 y PW-MO) - (Day\_7 n PW+MO) 5.9180 58.4272 48 0.101  
 (Day\_7 y PW-MO) - (Day\_1 y PW+MO) 1.7642 0.9310 48 1.895  
 (Day\_7 y PW-MO) - (Day\_3 y PW+MO) 4.0325 8.8678 48 0.455  
 (Day\_7 y PW-MO) - (Day\_5 y PW+MO) 4.3577 12.2759 48 0.355  
 (Day\_7 y PW-MO) - (Day\_7 y PW+MO) 6.2164 78.7442 48 0.079  
 (Day\_1 n PW+MO) - (Day\_3 n PW+MO) 1.4897 31.6222 48 0.047  
 (Day\_1 n PW+MO) - (Day\_5 n PW+MO) 1.6392 36.4907 48 0.045  
 (Day\_1 n PW+MO) - (Day\_7 n PW+MO) 2.1284 58.8394 48 0.036  
 (Day\_1 n PW+MO) - (Day\_1 y PW+MO) -2.0254 7.0147 48 -0.289  
 (Day\_1 n PW+MO) - (Day\_3 y PW+MO) 0.2429 11.2684 48 0.022  
 (Day\_1 n PW+MO) - (Day\_5 y PW+MO) 0.5682 14.1080 48 0.040  
 (Day\_1 n PW+MO) - (Day\_7 y PW+MO) 2.4268 79.0506 48 0.031  
 (Day\_3 n PW+MO) - (Day\_5 n PW+MO) 0.1495 47.2737 48 0.003  
 (Day\_3 n PW+MO) - (Day\_7 n PW+MO) 0.6387 66.0705 48 0.010  
 (Day\_3 n PW+MO) - (Day\_1 y PW+MO) -3.5151 30.8617 48 -0.114  
 (Day\_3 n PW+MO) - (Day\_3 y PW+MO) -1.2468 32.0969 48 -0.039  
 (Day\_3 n PW+MO) - (Day\_5 y PW+MO) -0.9215 33.2005 48 -0.028  
 (Day\_3 n PW+MO) - (Day\_7 y PW+MO) 0.9371 84.5708 48 0.011  
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 (Day\_5 n PW+MO) - (Day\_1 y PW+MO) -3.6646 35.8336 48 -0.102  
 (Day\_5 n PW+MO) - (Day\_3 y PW+MO) -1.3963 36.9028 48 -0.038  
 (Day\_5 n PW+MO) - (Day\_5 y PW+MO) -1.0710 37.8665 48 -0.028  
 (Day\_5 n PW+MO) - (Day\_7 y PW+MO) 0.7876 86.5091 48 0.009  
 (Day\_7 n PW+MO) - (Day\_1 y PW+MO) -4.1538 58.4342 48 -0.071  
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 (Day\_7 n PW+MO) - (Day\_5 y PW+MO) -1.5602 59.7024 48 -0.026  
 (Day\_7 n PW+MO) - (Day\_7 y PW+MO) 0.2984 98.0527 48 0.003  
 (Day\_1 y PW+MO) - (Day\_3 y PW+MO) 2.2683 8.9138 48 0.254  
 (Day\_1 y PW+MO) - (Day\_5 y PW+MO) 2.5936 12.3091 48 0.211  
 (Day\_1 y PW+MO) - (Day\_7 y PW+MO) 4.4522 78.7494 48 0.057  
 (Day\_3 y PW+MO) - (Day\_5 y PW+MO) 0.3253 15.1422 48 0.021  
 (Day\_3 y PW+MO) - (Day\_7 y PW+MO) 2.1839 79.2417 48 0.028  
 (Day\_5 y PW+MO) - (Day\_7 y PW+MO) 1.8586 79.6950 48 0.023  
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Results are given on the log (not the response) scale.   
P value adjustment: tukey method for comparing a family of 24 estimates

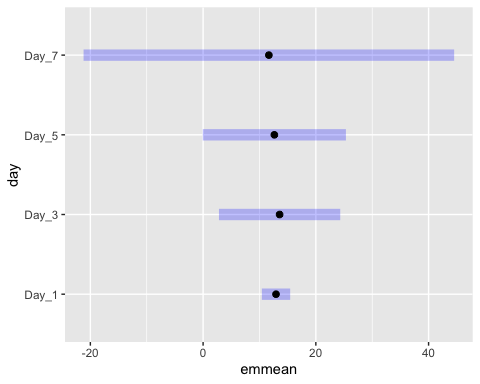
## First order comparisons  
  
# Pairwise comparisons for 'day'  
# None are sig  
pairwise\_day\_gaus\_glm <- emmeans(mod\_gaus\_glm, pairwise ~ day, adjust = "tukey")

NOTE: Results may be misleading due to involvement in interactions

pairwise\_day\_gaus\_glm # df infinity?? definitely sketchy

$emmeans  
 day emmean SE df lower.CL upper.CL  
 Day\_1 12.9 1.25 48 10.4206 15.4  
 Day\_3 13.6 5.35 48 2.8156 24.3  
 Day\_5 12.6 6.31 48 -0.0569 25.3  
 Day\_7 11.7 16.35 48 -21.2044 44.5  
  
Results are averaged over the levels of: TB, water\_treatment   
Results are given on the log (not the response) scale.   
Confidence level used: 0.95   
  
$contrasts  
 contrast estimate SE df t.ratio p.value  
 Day\_1 - Day\_3 -0.638 5.49 48 -0.116 0.9994  
 Day\_1 - Day\_5 0.295 6.44 48 0.046 1.0000  
 Day\_1 - Day\_7 1.267 16.40 48 0.077 0.9998  
 Day\_3 - Day\_5 0.933 8.28 48 0.113 0.9995  
 Day\_3 - Day\_7 1.905 17.20 48 0.111 0.9995  
 Day\_5 - Day\_7 0.973 17.53 48 0.056 0.9999  
  
Results are averaged over the levels of: TB, water\_treatment   
Results are given on the log (not the response) scale.   
P value adjustment: tukey method for comparing a family of 4 estimates

plot(pairwise\_day\_gaus\_glm)



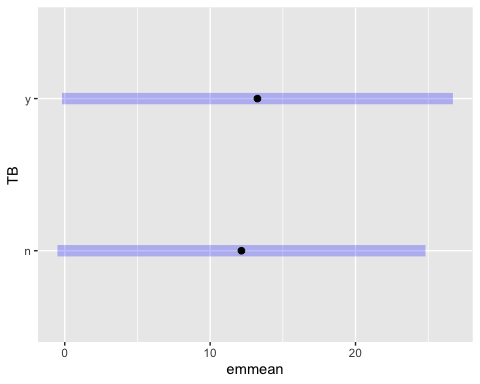
# Pairwise comparisons for 'TB'  
pairwise\_TB\_gaus\_glm <- emmeans(mod\_gaus\_glm, pairwise ~ TB, adjust = "tukey")

NOTE: Results may be misleading due to involvement in interactions

pairwise\_TB\_gaus\_glm

$emmeans  
 TB emmean SE df lower.CL upper.CL  
 n 12.2 6.29 48 -0.504 24.8  
 y 13.3 6.69 48 -0.190 26.7  
  
Results are averaged over the levels of: day, water\_treatment   
Results are given on the log (not the response) scale.   
Confidence level used: 0.95   
  
$contrasts  
 contrast estimate SE df t.ratio p.value  
 n - y -1.1 9.18 48 -0.120 0.9050  
  
Results are averaged over the levels of: day, water\_treatment   
Results are given on the log (not the response) scale.

plot(pairwise\_TB\_gaus\_glm)



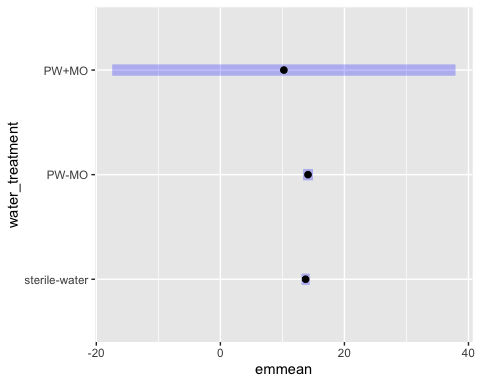
# Pairwise comparisons for 'water\_treatment'  
pairwise\_water\_treatment\_2b <- emmeans(mod\_gaus\_glm, pairwise ~ water\_treatment, adjust = "tukey")

NOTE: Results may be misleading due to involvement in interactions

pairwise\_water\_treatment\_2b

$emmeans  
 water\_treatment emmean SE df lower.CL upper.CL  
 sterile-water 13.7 0.333 48 13.1 14.4  
 PW-MO 14.1 0.399 48 13.3 14.9  
 PW+MO 10.2 13.766 48 -17.4 37.9  
  
Results are averaged over the levels of: day, TB   
Results are given on the log (not the response) scale.   
Confidence level used: 0.95   
  
$contrasts  
 contrast estimate SE df t.ratio p.value  
 (sterile-water) - (PW-MO) -0.385 0.519 48 -0.742 0.7399  
 (sterile-water) - (PW+MO) 3.511 13.770 48 0.255 0.9648  
 (PW-MO) - (PW+MO) 3.896 13.771 48 0.283 0.9569  
  
Results are averaged over the levels of: day, TB   
Results are given on the log (not the response) scale.   
P value adjustment: tukey method for comparing a family of 3 estimates

plot(pairwise\_water\_treatment\_2b)



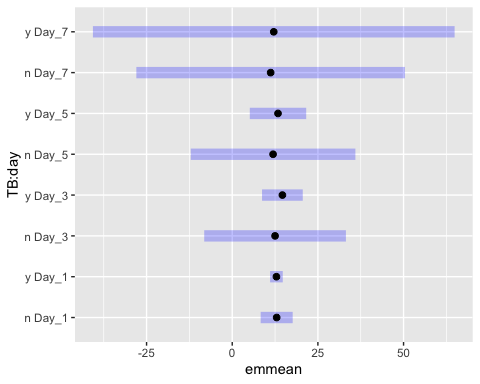
## second order comparisons  
  
# day:TB  
pairwise\_day\_TB\_2b <- emmeans(mod\_gaus\_glm, pairwise ~ TB \* day, adjust = "tukey")

NOTE: Results may be misleading due to involvement in interactions

pairwise\_day\_TB\_2b

$emmeans  
 TB day emmean SE df lower.CL upper.CL  
 n Day\_1 13.0 2.33 48 8.30 17.6  
 y Day\_1 12.9 0.92 48 11.05 14.7  
 n Day\_3 12.5 10.28 48 -8.17 33.2  
 y Day\_3 14.6 2.96 48 8.70 20.6  
 n Day\_5 11.9 11.95 48 -12.10 35.9  
 y Day\_5 13.4 4.09 48 5.13 21.6  
 n Day\_7 11.2 19.50 48 -27.98 50.4  
 y Day\_7 12.1 26.25 48 -40.66 64.9  
  
Results are averaged over the levels of: water\_treatment   
Results are given on the log (not the response) scale.   
Confidence level used: 0.95   
  
$contrasts  
 contrast estimate SE df t.ratio p.value  
 n Day\_1 - y Day\_1 0.0721 2.50 48 0.029 1.0000  
 n Day\_1 - n Day\_3 0.4672 10.54 48 0.044 1.0000  
 n Day\_1 - y Day\_3 -1.6712 3.76 48 -0.444 0.9998  
 n Day\_1 - n Day\_5 1.0492 12.17 48 0.086 1.0000  
 n Day\_1 - y Day\_5 -0.3879 4.71 48 -0.082 1.0000  
 n Day\_1 - n Day\_7 1.7565 19.63 48 0.089 1.0000  
 n Day\_1 - y Day\_7 0.8502 26.35 48 0.032 1.0000  
 y Day\_1 - n Day\_3 0.3951 10.33 48 0.038 1.0000  
 y Day\_1 - y Day\_3 -1.7433 3.10 48 -0.563 0.9992  
 y Day\_1 - n Day\_5 0.9771 11.98 48 0.082 1.0000  
 y Day\_1 - y Day\_5 -0.4600 4.20 48 -0.110 1.0000  
 y Day\_1 - n Day\_7 1.6844 19.52 48 0.086 1.0000  
 y Day\_1 - y Day\_7 0.7781 26.27 48 0.030 1.0000  
 n Day\_3 - y Day\_3 -2.1384 10.70 48 -0.200 1.0000  
 n Day\_3 - n Day\_5 0.5820 15.76 48 0.037 1.0000  
 n Day\_3 - y Day\_5 -0.8551 11.07 48 -0.077 1.0000  
 n Day\_3 - n Day\_7 1.2893 22.04 48 0.058 1.0000  
 n Day\_3 - y Day\_7 0.3830 28.19 48 0.014 1.0000  
 y Day\_3 - n Day\_5 2.7204 12.31 48 0.221 1.0000  
 y Day\_3 - y Day\_5 1.2833 5.05 48 0.254 1.0000  
 y Day\_3 - n Day\_7 3.4277 19.72 48 0.174 1.0000  
 y Day\_3 - y Day\_7 2.5214 26.42 48 0.095 1.0000  
 n Day\_5 - y Day\_5 -1.4371 12.63 48 -0.114 1.0000  
 n Day\_5 - n Day\_7 0.7073 22.87 48 0.031 1.0000  
 n Day\_5 - y Day\_7 -0.1990 28.84 48 -0.007 1.0000  
 y Day\_5 - n Day\_7 2.1444 19.92 48 0.108 1.0000  
 y Day\_5 - y Day\_7 1.2381 26.57 48 0.047 1.0000  
 n Day\_7 - y Day\_7 -0.9063 32.70 48 -0.028 1.0000  
  
Results are averaged over the levels of: water\_treatment   
Results are given on the log (not the response) scale.   
P value adjustment: tukey method for comparing a family of 8 estimates

plot(pairwise\_day\_TB\_2b)



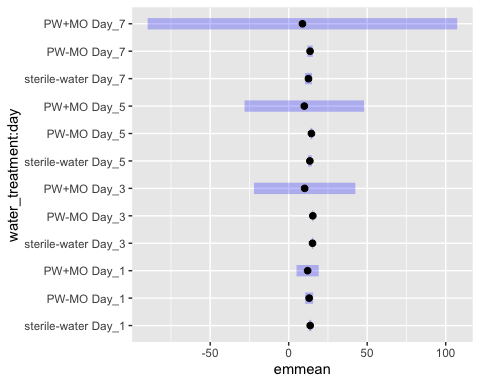
# day:water\_treatment  
pairwise\_water\_treatment\_day\_2b <- emmeans(mod\_gaus\_glm, pairwise ~ water\_treatment \* day, adjust = "tukey")

NOTE: Results may be misleading due to involvement in interactions

pairwise\_water\_treatment\_day\_2b

$emmeans  
 water\_treatment day emmean SE df lower.CL upper.CL  
 sterile-water Day\_1 13.70 0.349 48 13.0 14.4  
 PW-MO Day\_1 13.04 1.284 48 10.5 15.6  
 PW+MO Day\_1 12.06 3.507 48 5.0 19.1  
 sterile-water Day\_3 15.18 0.195 48 14.8 15.6  
 PW-MO Day\_3 15.36 0.176 48 15.0 15.7  
 PW+MO Day\_3 10.18 16.048 48 -22.1 42.4  
 sterile-water Day\_5 13.49 0.597 48 12.3 14.7  
 PW-MO Day\_5 14.49 0.296 48 13.9 15.1  
 PW+MO Day\_5 9.94 18.933 48 -28.1 48.0  
 sterile-water Day\_7 12.61 1.120 48 10.4 14.9  
 PW-MO Day\_7 13.63 0.881 48 11.9 15.4  
 PW+MO Day\_7 8.77 49.026 48 -89.8 107.3  
  
Results are averaged over the levels of: TB   
Results are given on the log (not the response) scale.   
Confidence level used: 0.95   
  
$contrasts  
 contrast estimate SE df t.ratio  
 (sterile-water Day\_1) - (PW-MO Day\_1) 0.6598 1.331 48 0.496  
 (sterile-water Day\_1) - (PW+MO Day\_1) 1.6475 3.525 48 0.467  
 (sterile-water Day\_1) - (sterile-water Day\_3) -1.4760 0.400 48 -3.690  
 (sterile-water Day\_1) - (PW-MO Day\_3) -1.6573 0.391 48 -4.235  
 (sterile-water Day\_1) - (PW+MO Day\_3) 3.5265 16.052 48 0.220  
 (sterile-water Day\_1) - (sterile-water Day\_5) 0.2149 0.691 48 0.311  
 (sterile-water Day\_1) - (PW-MO Day\_5) -0.7877 0.458 48 -1.721  
 (sterile-water Day\_1) - (PW+MO Day\_5) 3.7639 18.936 48 0.199  
 (sterile-water Day\_1) - (sterile-water Day\_7) 1.0942 1.173 48 0.933  
 (sterile-water Day\_1) - (PW-MO Day\_7) 0.0772 0.948 48 0.081  
 (sterile-water Day\_1) - (PW+MO Day\_7) 4.9378 49.028 48 0.101  
 (PW-MO Day\_1) - (PW+MO Day\_1) 0.9877 3.735 48 0.264  
 (PW-MO Day\_1) - (sterile-water Day\_3) -2.1358 1.299 48 -1.644  
 (PW-MO Day\_1) - (PW-MO Day\_3) -2.3171 1.296 48 -1.787  
 (PW-MO Day\_1) - (PW+MO Day\_3) 2.8667 16.100 48 0.178  
 (PW-MO Day\_1) - (sterile-water Day\_5) -0.4449 1.416 48 -0.314  
 (PW-MO Day\_1) - (PW-MO Day\_5) -1.4475 1.318 48 -1.098  
 (PW-MO Day\_1) - (PW+MO Day\_5) 3.1041 18.977 48 0.164  
 (PW-MO Day\_1) - (sterile-water Day\_7) 0.4344 1.704 48 0.255  
 (PW-MO Day\_1) - (PW-MO Day\_7) -0.5826 1.558 48 -0.374  
 (PW-MO Day\_1) - (PW+MO Day\_7) 4.2780 49.043 48 0.087  
 (PW+MO Day\_1) - (sterile-water Day\_3) -3.1235 3.513 48 -0.889  
 (PW+MO Day\_1) - (PW-MO Day\_3) -3.3048 3.512 48 -0.941  
 (PW+MO Day\_1) - (PW+MO Day\_3) 1.8790 16.427 48 0.114  
 (PW+MO Day\_1) - (sterile-water Day\_5) -1.4326 3.558 48 -0.403  
 (PW+MO Day\_1) - (PW-MO Day\_5) -2.4352 3.520 48 -0.692  
 (PW+MO Day\_1) - (PW+MO Day\_5) 2.1164 19.255 48 0.110  
 (PW+MO Day\_1) - (sterile-water Day\_7) -0.5533 3.682 48 -0.150  
 (PW+MO Day\_1) - (PW-MO Day\_7) -1.5703 3.616 48 -0.434  
 (PW+MO Day\_1) - (PW+MO Day\_7) 3.2903 49.152 48 0.067  
 (sterile-water Day\_3) - (PW-MO Day\_3) -0.1813 0.263 48 -0.690  
 (sterile-water Day\_3) - (PW+MO Day\_3) 5.0025 16.050 48 0.312  
 (sterile-water Day\_3) - (sterile-water Day\_5) 1.6909 0.628 48 2.694  
 (sterile-water Day\_3) - (PW-MO Day\_5) 0.6883 0.354 48 1.943  
 (sterile-water Day\_3) - (PW+MO Day\_5) 5.2399 18.934 48 0.277  
 (sterile-water Day\_3) - (sterile-water Day\_7) 2.5703 1.137 48 2.262  
 (sterile-water Day\_3) - (PW-MO Day\_7) 1.5532 0.903 48 1.721  
 (sterile-water Day\_3) - (PW+MO Day\_7) 6.4138 49.027 48 0.131  
 (PW-MO Day\_3) - (PW+MO Day\_3) 5.1838 16.049 48 0.323  
 (PW-MO Day\_3) - (sterile-water Day\_5) 1.8722 0.622 48 3.009  
 (PW-MO Day\_3) - (PW-MO Day\_5) 0.8696 0.344 48 2.525  
 (PW-MO Day\_3) - (PW+MO Day\_5) 5.4212 18.934 48 0.286  
 (PW-MO Day\_3) - (sterile-water Day\_7) 2.7515 1.133 48 2.427  
 (PW-MO Day\_3) - (PW-MO Day\_7) 1.7345 0.899 48 1.930  
 (PW-MO Day\_3) - (PW+MO Day\_7) 6.5951 49.027 48 0.135  
 (PW+MO Day\_3) - (sterile-water Day\_5) -3.3116 16.060 48 -0.206  
 (PW+MO Day\_3) - (PW-MO Day\_5) -4.3142 16.051 48 -0.269  
 (PW+MO Day\_3) - (PW+MO Day\_5) 0.2374 24.820 48 0.010  
 (PW+MO Day\_3) - (sterile-water Day\_7) -2.4323 16.087 48 -0.151  
 (PW+MO Day\_3) - (PW-MO Day\_7) -3.4493 16.073 48 -0.215  
 (PW+MO Day\_3) - (PW+MO Day\_7) 1.4113 51.586 48 0.027  
 (sterile-water Day\_5) - (PW-MO Day\_5) -1.0026 0.666 48 -1.505  
 (sterile-water Day\_5) - (PW+MO Day\_5) 3.5490 18.943 48 0.187  
 (sterile-water Day\_5) - (sterile-water Day\_7) 0.8793 1.269 48 0.693  
 (sterile-water Day\_5) - (PW-MO Day\_7) -0.1377 1.064 48 -0.129  
 (sterile-water Day\_5) - (PW+MO Day\_7) 4.7229 49.030 48 0.096  
 (PW-MO Day\_5) - (PW+MO Day\_5) 4.5516 18.936 48 0.240  
 (PW-MO Day\_5) - (sterile-water Day\_7) 1.8820 1.158 48 1.625  
 (PW-MO Day\_5) - (PW-MO Day\_7) 0.8649 0.930 48 0.930  
 (PW-MO Day\_5) - (PW+MO Day\_7) 5.7255 49.027 48 0.117  
 (PW+MO Day\_5) - (sterile-water Day\_7) -2.6696 18.966 48 -0.141  
 (PW+MO Day\_5) - (PW-MO Day\_7) -3.6867 18.954 48 -0.195  
 (PW+MO Day\_5) - (PW+MO Day\_7) 1.1739 52.555 48 0.022  
 (sterile-water Day\_7) - (PW-MO Day\_7) -1.0171 1.425 48 -0.714  
 (sterile-water Day\_7) - (PW+MO Day\_7) 3.8436 49.039 48 0.078  
 (PW-MO Day\_7) - (PW+MO Day\_7) 4.8606 49.034 48 0.099  
 p.value  
 1.0000  
 1.0000  
 0.0253  
 0.0052  
 1.0000  
 1.0000  
 0.8498  
 1.0000  
 0.9984  
 1.0000  
 1.0000  
 1.0000  
 0.8834  
 0.8165  
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 1.0000  
 0.9989  
 0.9982  
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 1.0000  
 0.9999  
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 1.0000  
 1.0000  
 0.9999  
 1.0000  
 0.2603  
 0.7271  
 1.0000  
 0.5161  
 0.8498  
 1.0000  
 1.0000  
 0.1375  
 0.3502  
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 0.4084  
 0.7353  
 1.0000  
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 1.0000  
 1.0000  
 0.9318  
 1.0000  
 0.9999  
 1.0000  
 1.0000  
 1.0000  
 0.8911  
 0.9984  
 1.0000  
 1.0000  
 1.0000  
 1.0000  
 0.9999  
 1.0000  
 1.0000  
  
Results are averaged over the levels of: TB   
Results are given on the log (not the response) scale.   
P value adjustment: tukey method for comparing a family of 12 estimates

plot(pairwise\_water\_treatment\_day\_2b)



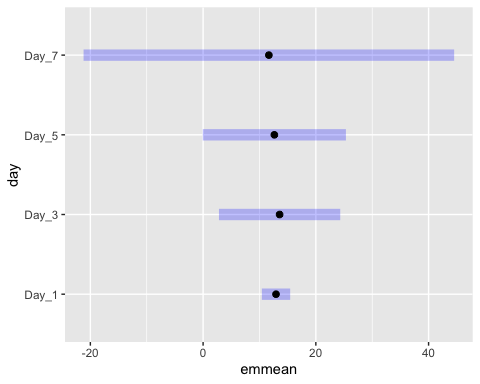
pairwise\_day\_2b <- emmeans(mod\_gaus\_glm, pairwise ~ day, adjust = "tukey")

NOTE: Results may be misleading due to involvement in interactions

pairwise\_day\_2b # df infinity?? definitely sketchy

$emmeans  
 day emmean SE df lower.CL upper.CL  
 Day\_1 12.9 1.25 48 10.4206 15.4  
 Day\_3 13.6 5.35 48 2.8156 24.3  
 Day\_5 12.6 6.31 48 -0.0569 25.3  
 Day\_7 11.7 16.35 48 -21.2044 44.5  
  
Results are averaged over the levels of: TB, water\_treatment   
Results are given on the log (not the response) scale.   
Confidence level used: 0.95   
  
$contrasts  
 contrast estimate SE df t.ratio p.value  
 Day\_1 - Day\_3 -0.638 5.49 48 -0.116 0.9994  
 Day\_1 - Day\_5 0.295 6.44 48 0.046 1.0000  
 Day\_1 - Day\_7 1.267 16.40 48 0.077 0.9998  
 Day\_3 - Day\_5 0.933 8.28 48 0.113 0.9995  
 Day\_3 - Day\_7 1.905 17.20 48 0.111 0.9995  
 Day\_5 - Day\_7 0.973 17.53 48 0.056 0.9999  
  
Results are averaged over the levels of: TB, water\_treatment   
Results are given on the log (not the response) scale.   
P value adjustment: tukey method for comparing a family of 4 estimates

plot(pairwise\_day\_2b, xlim = c(8, 16))



# \*Publication figures

Custom theme

# install.packages("extrafont")  
# library(extrafont)  
# font\_import(pattern = "Arial")  
# loadfonts(device = "pdf")  
  
# set up custom theme  
myCustomTheme <- function() {  
 theme\_light() +  
 theme(axis.text = element\_text(size = 7, family = "Helvetica", color = "black"),  
 axis.title.x = element\_text(margin = margin(t = 10), size = 7, family = "Helvetica", color = "black"), # Add space between x-axis label and axis  
 axis.title.y = element\_text(margin = margin(r = 10), size = 7, family = "Helvetica", color = "black"), # Add space between y-axis label and axis  
 title = element\_text(size = 7, face = "bold", family = "Helvetica"),  
 plot.caption = element\_text(size = 7, face = "italic", family = "Helvetica"),  
 legend.text = element\_text(size = 7, family = "Helvetica"), # Increase legend text size  
 panel.grid = element\_blank(), # Remove all grid lines (both major and minor)  
 # axis.line.x = element\_line(color = "grey"), # Keep the x-axis line  
 # axis.line.y = element\_line(color = "grey"), # Keep the y-axis line  
 axis.ticks = element\_line(color = "grey", size = 0.5), # Keep tick markers  
 axis.ticks.x = element\_line(color = "grey", size = 0.5), # ensure bottom axis ticks  
 axis.ticks.y = element\_line(color = "grey", size = 0.5), # <- ensure side axis ticks  
 strip.text = element\_text(size = 7, face = "bold", family = "Helvetica", color = "black"), # Set strip text style  
 strip.background = element\_rect(fill = "white", color = "grey", size = 0.5) # Set strip background to white, outline grey  
 )  
}

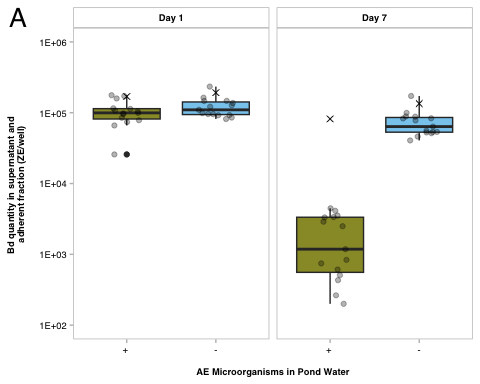
# SFEB microorganisms (3A)

fig\_SFEB\_microorganisms <- eb\_pw %>%  
 # combine floating and adherent for total\_Bd  
 pivot\_wider(names\_from = bd\_location, values\_from = bd\_qty) %>%  
 mutate(combined\_bd = adherent + floating) %>%   
   
 # create the plot  
 ggplot(aes(y= combined\_bd, x = filter, fill = filter)) +   
 geom\_boxplot() +  
 geom\_jitter(width = 0.2, alpha = 0.3) +  
 # scale\_y\_log10(labels = function(x) {gsub("e", "E", x = scales::scientific\_format()(x))}) + # Custom scientific notation  
 scale\_y\_log10(labels = function(x) {gsub("e", "E", scales::scientific\_format()(x))},   
 limits = c(1e+02, 1e+06)) +   
   
 facet\_wrap(~day, labeller = labeller(day = c("Day\_1" = "Day 1",  
 "Day\_7" = "Day 7")))+  
   
 scale\_fill\_manual(values = c("40um\_filter" = with\_microbes\_40\_color,   
 "0.22um\_filter" = no\_microbes\_.22\_color)) +  
 myCustomTheme() +  
 theme(legend.position = "none",  
 panel.border = element\_rect(color = "gray", size = 0.5, fill = NA)) +   
   
 scale\_x\_discrete (labels= c("40um\_filter" = "+ ", "0.22um\_filter" = "-")) +  
 xlab("AE Microorganisms in Pond Water") +  
 ylab("Bd quantity in supernatant and \nadherent fraction (ZE/well)") +  
   
 # add controls ad x's  
 geom\_point(data = eb\_pw\_controls, aes(x = filter, y = combined\_bd), shape = 4, size = 2)

Warning: The `size` argument of `element\_line()` is deprecated as of ggplot2 3.4.0.  
ℹ Please use the `linewidth` argument instead.

Warning: The `size` argument of `element\_rect()` is deprecated as of ggplot2 3.4.0.  
ℹ Please use the `linewidth` argument instead.

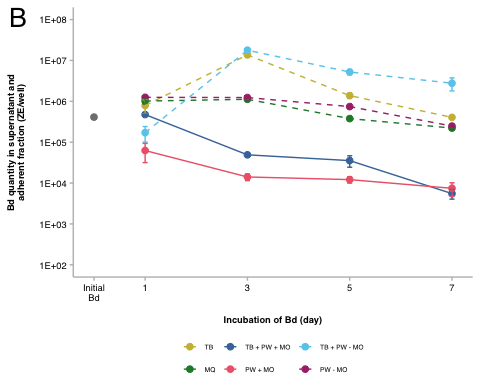
fig\_SFEB\_microorganisms <- fig\_SFEB\_microorganisms +  
 labs(tag = "A") +  
 theme(  
 plot.tag = element\_text(family = "Helvetica", size = 20, face = "plain", hjust = -0.1, vjust = 1),  
 plot.tag.position = c(0, 1)  
 )  
  
fig\_SFEB\_microorganisms



ggsave("paper-figures/expt2-SFEB\_AE\_microorgranisms\_fig3a\_updated.pdf", plot = fig\_SFEB\_microorganisms, width = 3.46, height = 3.46)

# SBNCOS microorganisms (3B)

SBNCOS\_AE\_microorgranisms\_fig3b <- pw\_summary %>%   
 # reorder to have them appear in desired order  
 mutate(sample\_ID = factor(sample\_ID,   
 levels = c("1%TB", "MQ", "1%TB+PW+microorganism", "PW+microorganism", "1%TB+PW-microorganism", "PW-microorganism", "Added Bd"))) %>%   
 ggplot(aes(x = day\_numeric,   
 y = mean,   
 color = sample\_ID)) +  
 geom\_point(size = 2) +  
 geom\_errorbar(aes(ymin = mean - se, # plot the standard error  
 ymax = mean + se),  
 width = 0.1) +  
  
 # Adding the raw data as a layer with jitter, Renwei didn't like this so it is commented out  
 # geom\_point(data = pw\_noday0,   
 # aes(x = day\_numeric,   
 # y = adh\_plus\_sup,   
 # color = sample\_ID), # Raw data points  
 # position = position\_jitter(width = 0.1, seed = 1),  
 # alpha = 0.3) +  
 # # add control raw data too  
 # geom\_point(data = pw\_control\_data,   
 # aes(x = day\_numeric,   
 # y = adh\_plus\_sup,   
 # color = "#BBBBBB"), # Raw data points  
 # position = position\_jitter(width = 0.1, seed = 1),  
 # alpha = 0.3) +  
  
## Update y axis scale per reviewer request!  
 scale\_y\_log10(limits = c(1e2, 1e8),   
 breaks = c(1e2, 1e3, 1e4, 1e5, 1e6, 1e7, 1e8),  
 labels = function(x) {gsub("e", "E", scales::scientific\_format()(x))}) +  
 labs(x = "Incubation of Bd (day)",  
 y = "Bd quantity in supernatant and\nadherent fraction (ZE/well)",  
 color = "Medium", # Title for color legend  
 linetype = "Microbes\nPresent" # Title for linetype legend  
 ) +  
 scale\_color\_manual(values = c("1%TB" = "#CCBB44",   
 "MQ" = "#228833",   
 "1%TB+PW+microorganism" = "#4477AA",   
 "PW+microorganism" = "#EE6677",   
 "1%TB+PW-microorganism" = "#66CCEE",  
 #"Added Bd" = "#BBBBBB" # removed bc not really a medium  
 "PW-microorganism" = "#AA3377"),   
 labels = c("1%TB" = "TB",  
 "MQ" = "MQ",  
 "1%TB+PW+microorganism" = "TB + PW + MO",  
 "PW+microorganism" = "PW + MO",  
 "1%TB+PW-microorganism" = "TB + PW - MO",  
 "PW-microorganism" = "PW - MO",  
 "Added Bd" = "Initial Bd")) + # Custom labels for the color legend  
   
 geom\_line(aes(linetype = microbes), show.legend = FALSE) +   
 scale\_linetype\_manual(values = c("n" = "dashed",   
 "y" = "solid"),  
 labels = c("n" = "N", "y" = "Y")) + # Change labels to uppercase N and Y  
 myCustomTheme()+  
 scale\_x\_continuous(breaks = c(0, 1, 3, 5, 7),  
 labels = c("Initial\nBd", "1", "3", "5", "7")) +  
 theme(legend.position = "bottom",  
 panel.border = element\_blank(),  
 legend.text = element\_text(size = 5), # Set legend text font size to 5pt  
 legend.key.size = unit(0.4, "cm"), # Reduce size of legend keys  
 legend.spacing.y = unit(0.1, "cm"), # Reduce vertical spacing between legend items  
 legend.margin = margin(t = 0, r = 0, b = 0, l = 0), # Remove margins around legend  
 axis.line.x = element\_line(color = "grey", size = 0.5), # Keep the x-axis line, make ~2.35 pt  
 axis.line.y = element\_line(color = "grey", size = 0.5)) + # Keep the x-axis line, make ~2.35 pt  
  
 guides(color = guide\_legend(title = NULL))  
  
#SBNCOS\_AE\_microorgranisms\_fig3b  
  
SBNCOS\_AE\_microorgranisms\_fig3b <- SBNCOS\_AE\_microorgranisms\_fig3b +  
 labs(tag = "B") +  
 theme(  
 plot.tag = element\_text(family = "Helvetica", size = 20, face = "plain", hjust = -0.1, vjust = 1),  
 plot.tag.position = c(0, 1)  
 )  
  
SBNCOS\_AE\_microorgranisms\_fig3b



ggsave("paper-figures/expt2-SBNCOS\_AE\_microorgranisms\_fig3b\_updated.pdf", plot = SBNCOS\_AE\_microorgranisms\_fig3b, width = 3.46, height = 3.46)

# \*SI figures and tables

## Anova table

Not in paper, stating information in sentences and using CLD plot instead

# anova table  
anova\_output <- tidy(aov\_sbncos)  
  
aov\_sbncos\_tbl <- anova\_output %>%  
 dplyr::select(term, df, sumsq, meansq, statistic, p.value) %>%  
 gt() %>%  
 tab\_header(  
 title = "ANOVA Table"  
 ) %>%  
 fmt\_number(  
 columns = c(sumsq, meansq, statistic),  
 decimals = 2  
 ) %>%  
 cols\_label(  
 term = "Term",  
 df = "Df",  
 sumsq = "Sum Sq",  
 meansq = "Mean Sq",  
 statistic = "F value",  
 p.value = "P-value"  
 ) %>% # scientific number format for values <0.001 in p values  
 fmt\_scientific(  
 columns = c(p.value),  
 decimals = 1,  
 rows = p.value < 0.001  
 ) %>%  
 # 3 decimals for p values >=0.001  
 fmt\_number(  
 columns = c(p.value),  
 decimals = 3,  
 rows = p.value >= 0.001  
 )  
aov\_sbncos\_tbl

Table 1: ANOVA Table

| Term | Df | Sum Sq | Mean Sq | F value | P-value |
| --- | --- | --- | --- | --- | --- |
| day | 3 | 35.40 | 11.80 | 45.61 | 4.3 × 10^-14 |
| TB | 1 | 20.99 | 20.99 | 81.13 | 6.9 × 10^-12 |
| water\_treatment | 2 | 228.85 | 114.42 | 442.25 | 1.2 × 10^-31 |
| day:TB | 3 | 11.71 | 3.90 | 15.08 | 4.8 × 10^-7 |
| day:water\_treatment | 6 | 37.33 | 6.22 | 24.05 | 6.4 × 10^-13 |
| TB:water\_treatment | 2 | 0.06 | 0.03 | 0.11 | 0.897 |
| day:TB:water\_treatment | 6 | 24.57 | 4.09 | 15.82 | 6.3 × 10^-10 |
| Residuals | 48 | 12.42 | 0.26 | NA | NA |

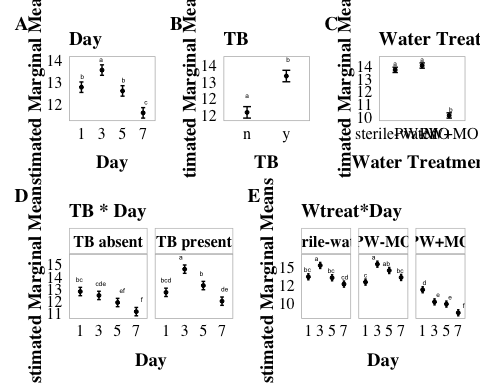
# prettier, simplified  
anova\_output <- tidy(aov\_sbncos)  
  
# Modify term to include degrees of freedom in \*italics\*  
anova\_output <- anova\_output %>%  
 mutate(term = ifelse(grepl("day:medium", term), "day x medium", term)) %>%   
 mutate (term = paste0(term, " (\*df = ", df, ", ", anova\_output[df == max(df), "df"], "\*)")) %>%   
 filter(term != "Residuals (\*df = 48, 48\*)")  
  
# Create the gt table with selected columns  
aov\_sbncos\_tbl\_b <- anova\_output %>%  
 dplyr::select(term, statistic, p.value) %>%  
 gt() %>%  
 tab\_header(  
 title = "ANOVA Table"  
 ) %>%  
 fmt\_markdown(  
 columns = c(term)  
 ) %>%  
 fmt\_number(  
 columns = c(statistic),  
 decimals = 2  
 ) %>%  
 cols\_label(  
 term = "",  
 statistic = "F value",  
 p.value = "P-value"  
 ) %>%  
 fmt\_scientific(  
 columns = c(p.value),  
 decimals = 1,  
 rows = p.value < 0.001  
 ) %>%  
 fmt\_number(  
 columns = c(p.value),  
 decimals = 3,  
 rows = p.value >= 0.001  
 )  
  
aov\_sbncos\_tbl\_b

Table 1: ANOVA Table

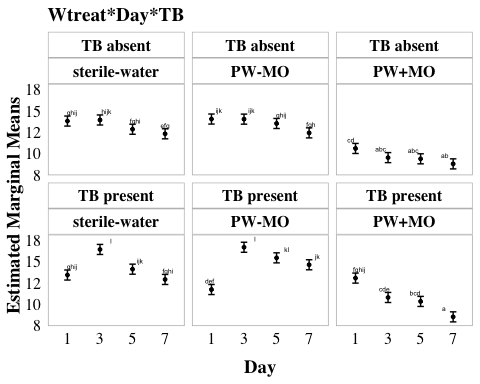
|  | F value | P-value |
| --- | --- | --- |
| day (*df = 3, 48*) | 45.61 | 4.3 × 10^-14 |
| TB (*df = 1, 48*) | 81.13 | 6.9 × 10^-12 |
| water\_treatment (*df = 2, 48*) | 442.25 | 1.2 × 10^-31 |
| day:TB (*df = 3, 48*) | 15.08 | 4.8 × 10^-7 |
| day:water\_treatment (*df = 6, 48*) | 24.05 | 6.4 × 10^-13 |
| TB:water\_treatment (*df = 2, 48*) | 0.11 | 0.897 |
| day:TB:water\_treatment (*df = 6, 48*) | 15.82 | 6.3 × 10^-10 |

## cld plots

pairwise\_cld\_2b <- (cld\_day\_2b + cld\_TB\_2b + cld\_water\_treatment\_2b) / (cld\_tb\_day\_int\_2b + cld\_watertreat\_day\_int\_2b) +  
 plot\_annotation(tag\_levels = 'A')  
  
# Display the combined plot  
pairwise\_cld\_2b



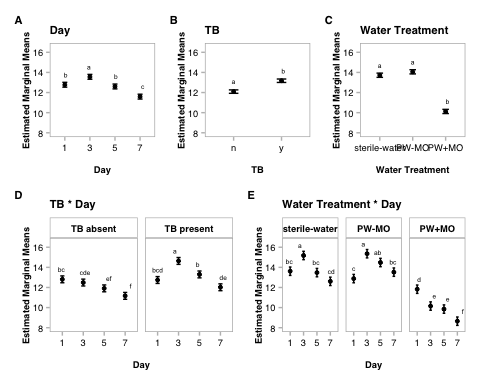
#ggsave("paper-figures/SI\_2b.pdf", plot = pairwise\_cld\_2b, width = 7.09, height = 3.46)  
  
cld\_water\_thirdorder\_2b



#ggsave("paper-figures/SI\_2b\_thirdorder.pdf", plot = cld\_water\_thirdorder\_2b , width = 7.09, height = 3.46)

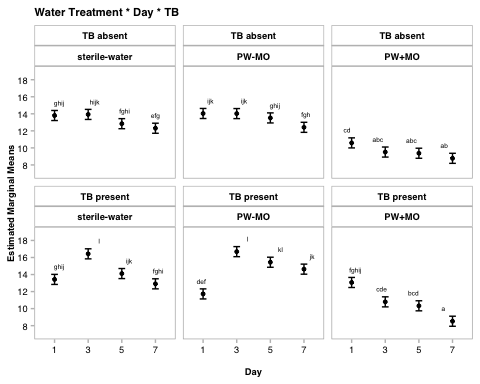
## Renwei y axis specs

global\_y\_limits <- c(8, 16.5)  
global\_y\_breaks <- seq(8, 16, by = 2)  
  
# Plot for 'day'  
cld\_day\_2b <- ggplot(cld\_day, aes(x = day, y = emmean)) +  
 geom\_point(size = 1) +  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) +  
 geom\_text(aes(label = .group), nudge\_y = 1, size = 1.75, color = "black") +  
 xlab("Day") +  
 ylab("Estimated Marginal Means") +  
 scale\_y\_continuous(labels = scales::label\_number(accuracy = 1), limits = global\_y\_limits, breaks = global\_y\_breaks) +  
 ggtitle("Day") +  
 scale\_x\_discrete(labels = c("Day\_1" = "1", "Day\_3" = "3", "Day\_5" = "5", "Day\_7" = "7")) +  
 myCustomTheme() +  
 theme(axis.title.y = element\_text(margin = margin(r = 1)))  
  
# Plot for 'TB'  
cld\_TB\_2b <- ggplot(cld\_TB, aes(x = TB, y = emmean)) +  
 geom\_point(size = 1) +  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) +  
 geom\_text(aes(label = .group), nudge\_y = 1, size = 1.75, color = "black") +  
 xlab("TB") +  
 ylab("Estimated Marginal Means") +  
 scale\_y\_continuous(labels = scales::label\_number(accuracy = 1), limits = global\_y\_limits, breaks = global\_y\_breaks) +  
 ggtitle("TB") +  
 myCustomTheme() +  
 theme(axis.title.y = element\_text(margin = margin(r = 1)))  
  
# Plot for 'water\_treatment'  
cld\_water\_treatment\_2b <- ggplot(cld\_water\_treatment, aes(x = water\_treatment, y = emmean)) +  
 geom\_point(size = 1) +  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) +  
 geom\_text(aes(label = .group), nudge\_y = 1, size = 1.75, color = "black") +  
 xlab("Water Treatment") +  
 ylab("Estimated Marginal Means") +  
 scale\_y\_continuous(labels = scales::label\_number(accuracy = 1), limits = global\_y\_limits, breaks = global\_y\_breaks) +  
 ggtitle("Water Treatment") +  
 myCustomTheme() +  
 theme(axis.title.y = element\_text(margin = margin(r = 1)))  
  
# Plot for 'TB \* day'  
tb\_labels <- c("n" = "TB absent", "y" = "TB present")  
cld\_tb\_day\_int\_2b <- ggplot(cld\_day\_TB, aes(x = factor(day), y = emmean)) +  
 geom\_point(size = 1) +  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) +  
 geom\_text(aes(label = .group), nudge\_y = 1, size = 1.75, color = "black") +  
 facet\_wrap(~ TB, labeller = as\_labeller(tb\_labels)) +  
 xlab("Day") +  
 ylab("Estimated Marginal Means") +  
 scale\_y\_continuous(labels = scales::label\_number(accuracy = 1), limits = global\_y\_limits, breaks = global\_y\_breaks) +  
 ggtitle("TB \* Day") +  
 scale\_x\_discrete(labels = c("Day\_1" = "1", "Day\_3" = "3", "Day\_5" = "5", "Day\_7" = "7")) +  
 myCustomTheme() +  
 theme(axis.title.y = element\_text(margin = margin(r = 1)))  
  
  
# Plot for 'water\_treatment \* day'  
cld\_watertreat\_day\_int\_2b <- ggplot(cld\_water\_treatment\_day, aes(x = factor(day), y = emmean)) +  
 geom\_point(size = 1) +  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) +  
 geom\_text(aes(label = .group), nudge\_y = 1, size = 1.75, color = "black") +  
 facet\_wrap(~ water\_treatment) +  
 xlab("Day") +  
 ylab("Estimated Marginal Means") +  
 scale\_y\_continuous(labels = scales::label\_number(accuracy = 1), limits = global\_y\_limits, breaks = global\_y\_breaks) +  
 ggtitle("Water Treatment \* Day") +  
 scale\_x\_discrete(labels = c("Day\_1" = "1", "Day\_3" = "3", "Day\_5" = "5", "Day\_7" = "7")) +  
 myCustomTheme() +  
 theme(axis.title.y = element\_text(margin = margin(r = 1)))  
  
pairwise\_cld\_2b <- (cld\_day\_2b + cld\_TB\_2b + cld\_water\_treatment\_2b) /  
 (cld\_tb\_day\_int\_2b + cld\_watertreat\_day\_int\_2b) +  
 plot\_annotation(tag\_levels = 'A')  
  
pairwise\_cld\_2b



#ggsave("paper-figures/SI\_2b\_updated.pdf", plot = pairwise\_cld\_2b, width = 7.09, height = 3.46)

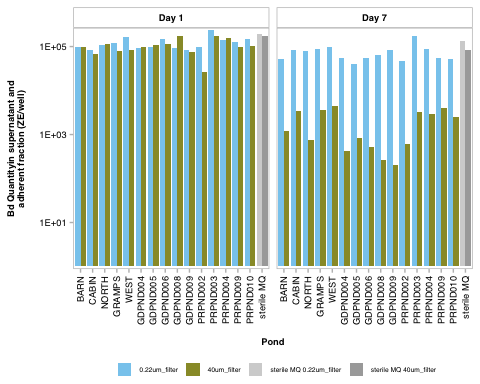
global\_y\_limits <- c(7, 19)  
global\_y\_breaks <- seq(8, 18, by = 2)  
  
cld\_water\_thirdorder\_2b <- ggplot(cld\_water\_thirdorder, aes(x = factor(day), y = emmean)) +  
 geom\_point(size = 1) +  
 geom\_errorbar(aes(ymin = lower.CL, ymax = upper.CL), width = 0.2) +  
 geom\_text(aes(label = .group), nudge\_y = 1.5, size = 1.75, color = "black") +  
 facet\_wrap(TB ~ water\_treatment, labeller = labeller(TB = tb\_labels)) +  
 xlab("Day") +  
 ylab("Estimated Marginal Means") +  
 scale\_y\_continuous(  
 labels = scales::label\_number(accuracy = 1),   
 limits = global\_y\_limits,   
 breaks = global\_y\_breaks  
 ) +  
 ggtitle("Water Treatment \* Day \* TB") +  
 scale\_x\_discrete(labels = c("Day\_1" = "1", "Day\_3" = "3", "Day\_5" = "5", "Day\_7" = "7")) +  
 myCustomTheme() +  
 theme(axis.title.y = element\_text(margin = margin(r = 1)))  
  
cld\_water\_thirdorder\_2b



#ggsave("paper-figures/SI\_2b\_thirdorder\_updated.pdf", plot = cld\_water\_thirdorder\_2b , width = 7.09, height = 3.46)

## Figure S2 Raw EB poond water data barplot

# Combine the two datasets (eb\_pw and eb\_pw\_controls)  
eb\_pw\_controls <- eb\_pw\_controls %>%  
 mutate(filter = case\_when(  
 filter == "40um\_filter" ~ "sterile MQ 40um\_filter",  
 filter == "0.22um\_filter" ~ "sterile MQ 0.22um\_filter",  
 TRUE ~ filter  
 ))  
  
combined\_data <- bind\_rows(  
 eb\_pw %>%  
 # combine floating and adherent for total Bd  
 pivot\_wider(names\_from = bd\_location, values\_from = bd\_qty) %>%  
 mutate(combined\_bd = adherent + floating),  
 eb\_pw\_controls # controls data is already in the required format  
)  
  
fig\_SI2A <- combined\_data %>%  
 ggplot(aes(y = combined\_bd, x = site, fill = filter)) +   
 geom\_col(position = position\_dodge()) +  
scale\_y\_continuous(expand = c(0.01, 0.01),  
 trans = "log", # Natural logarithmic scale  
 breaks = c(1e+01, 1e+03, 1e+05), # Set exact breaks  
 # labels = scales::label\_scientific(),  
 labels = function(x) {gsub("e", "E", scales::label\_scientific()(x))}  
 ) + # Use scientific notation 1e+01, 1e+03, 1e+05  
 #scale\_y\_log10() + #same thing, but created weird spacing in the facet so using abpve method  
 facet\_wrap(~day, labeller = labeller(day = c("Day\_1" = "Day 1", "Day\_7" = "Day 7"))) +  
 scale\_x\_discrete(limits = c("BARN", "CABIN", "NORTH", "GRAMPS", "WEST", "GDPND004", "GDPND005", "GDPND006", "GDPND008", "GDPND009", "PRPND002", "PRPND003", "PRPND004", "PRPND009", "PRPND010", "sterile MQ")) + # Order "MQ" last  
 scale\_fill\_manual(values = c(  
 "40um\_filter" = with\_microbes\_40\_color,   
 "0.22um\_filter" = no\_microbes\_.22\_color,  
 "sterile MQ 40um\_filter" = "darkgray",  
 "sterile MQ 0.22um\_filter" = "lightgray"  
 )) +  
 myCustomTheme() +   
 theme(axis.text.x = element\_text(angle = 90, vjust = 0.5, hjust = 1),  
 legend.position = "bottom",  
 panel.border = element\_rect(color = "gray", size = 0.5, fill = NA),  
 legend.text = element\_text(size = 5), # Set legend text font size to 5pt  
 legend.key.size = unit(0.4, "cm"), # Reduce size of legend keys  
 legend.spacing.y = unit(0.1, "cm"), # Reduce vertical spacing between legend items  
 legend.margin = margin(t = 0, r = 0, b = 0, l = 0)) + # Remove margins around legend) + # Keep the x-axis line, make ~2.35 pt  
 xlab("Pond") +  
 ylab("Bd Quantityin supernatant and\nadherent fraction (ZE/well)") +  
 guides(fill = guide\_legend(title = ""))  
  
fig\_SI2A



#ggsave("paper-figures/SI\_FigS2.pdf", plot = fig\_SI2A, width = 7.09, height = 3.46)

## 2b posthoc table

We likely will not include this, but if we need to find these specific t and p values we can locate them here

ph\_2b\_day\_df <- as.data.frame(ph\_2b\_day)  
ph\_2b\_TB\_df <- as.data.frame(ph\_2b\_TB)  
ph\_2b\_water\_treatment\_df <- as.data.frame(ph\_2b\_water\_treatment)  
ph\_2b\_water\_treatment\_day\_df <- as.data.frame(ph\_2b\_water\_treatment\_day)  
ph\_2b\_day\_TB\_df <- as.data.frame(ph\_2b\_day\_TB)  
   
ph\_2b\_day\_df <- ph\_2b\_day\_df %>% mutate(factor = "Day")  
ph\_2b\_TB\_df <- ph\_2b\_TB\_df %>% mutate(factor = "TB")  
ph\_2b\_water\_treatment\_df <- ph\_2b\_water\_treatment\_df %>% mutate(factor = "WTreat")  
ph\_2b\_water\_treatment\_day\_df <- ph\_2b\_water\_treatment\_day\_df %>% mutate(factor = "Day\*WTreat")  
ph\_2b\_day\_TB\_df <- ph\_2b\_day\_TB\_df %>% mutate(factor = "Day\*TB")  
  
# combine all pairwise comparisons  
f2b\_all\_tukey\_df <- bind\_rows(ph\_2b\_day\_df, ph\_2b\_TB\_df, ph\_2b\_water\_treatment\_df, ph\_2b\_water\_treatment\_day\_df, ph\_2b\_day\_TB\_df)  
  
f2b\_all\_tukey\_df

contrast estimate SE df  
1 Day\_1 - Day\_3 -0.78783861 0.1695522 48  
2 Day\_1 - Day\_5 0.17150692 0.1695522 48  
3 Day\_1 - Day\_7 1.18175034 0.1695522 48  
4 Day\_3 - Day\_5 0.95934552 0.1695522 48  
5 Day\_3 - Day\_7 1.96958894 0.1695522 48  
6 Day\_5 - Day\_7 1.01024342 0.1695522 48  
7 n - y -1.07987165 0.1198915 48  
8 (sterile-water) - (PW-MO) -0.34028396 0.1468365 48  
9 (sterile-water) - (PW+MO) 3.60029322 0.1468365 48  
10 (PW-MO) - (PW+MO) 3.94057719 0.1468365 48  
11 (sterile-water Day\_1) - (PW-MO Day\_1) 0.73277523 0.2936731 48  
12 (sterile-water Day\_1) - (PW+MO Day\_1) 1.78762409 0.2936731 48  
13 (sterile-water Day\_1) - (sterile-water Day\_3) -1.56409952 0.2936731 48  
14 (sterile-water Day\_1) - (PW-MO Day\_3) -1.74122159 0.2936731 48  
15 (sterile-water Day\_1) - (PW+MO Day\_3) 3.46220461 0.2936731 48  
16 (sterile-water Day\_1) - (sterile-water Day\_5) 0.13666277 0.2936731 48  
17 (sterile-water Day\_1) - (PW-MO Day\_5) -0.86539619 0.2936731 48  
18 (sterile-water Day\_1) - (PW+MO Day\_5) 3.76365348 0.2936731 48  
19 (sterile-water Day\_1) - (sterile-water Day\_7) 1.00670881 0.2936731 48  
20 (sterile-water Day\_1) - (PW-MO Day\_7) 0.09197876 0.2936731 48  
21 (sterile-water Day\_1) - (PW+MO Day\_7) 4.96696276 0.2936731 48  
22 (PW-MO Day\_1) - (PW+MO Day\_1) 1.05484887 0.2936731 48  
23 (PW-MO Day\_1) - (sterile-water Day\_3) -2.29687475 0.2936731 48  
24 (PW-MO Day\_1) - (PW-MO Day\_3) -2.47399681 0.2936731 48  
25 (PW-MO Day\_1) - (PW+MO Day\_3) 2.72942939 0.2936731 48  
26 (PW-MO Day\_1) - (sterile-water Day\_5) -0.59611245 0.2936731 48  
27 (PW-MO Day\_1) - (PW-MO Day\_5) -1.59817142 0.2936731 48  
28 (PW-MO Day\_1) - (PW+MO Day\_5) 3.03087826 0.2936731 48  
29 (PW-MO Day\_1) - (sterile-water Day\_7) 0.27393358 0.2936731 48  
30 (PW-MO Day\_1) - (PW-MO Day\_7) -0.64079647 0.2936731 48  
31 (PW-MO Day\_1) - (PW+MO Day\_7) 4.23418754 0.2936731 48  
32 (PW+MO Day\_1) - (sterile-water Day\_3) -3.35172362 0.2936731 48  
33 (PW+MO Day\_1) - (PW-MO Day\_3) -3.52884568 0.2936731 48  
34 (PW+MO Day\_1) - (PW+MO Day\_3) 1.67458052 0.2936731 48  
35 (PW+MO Day\_1) - (sterile-water Day\_5) -1.65096132 0.2936731 48  
36 (PW+MO Day\_1) - (PW-MO Day\_5) -2.65302028 0.2936731 48  
37 (PW+MO Day\_1) - (PW+MO Day\_5) 1.97602939 0.2936731 48  
38 (PW+MO Day\_1) - (sterile-water Day\_7) -0.78091529 0.2936731 48  
39 (PW+MO Day\_1) - (PW-MO Day\_7) -1.69564533 0.2936731 48  
40 (PW+MO Day\_1) - (PW+MO Day\_7) 3.17933867 0.2936731 48  
41 (sterile-water Day\_3) - (PW-MO Day\_3) -0.17712206 0.2936731 48  
42 (sterile-water Day\_3) - (PW+MO Day\_3) 5.02630414 0.2936731 48  
43 (sterile-water Day\_3) - (sterile-water Day\_5) 1.70076230 0.2936731 48  
44 (sterile-water Day\_3) - (PW-MO Day\_5) 0.69870333 0.2936731 48  
45 (sterile-water Day\_3) - (PW+MO Day\_5) 5.32775301 0.2936731 48  
46 (sterile-water Day\_3) - (sterile-water Day\_7) 2.57080833 0.2936731 48  
47 (sterile-water Day\_3) - (PW-MO Day\_7) 1.65607828 0.2936731 48  
48 (sterile-water Day\_3) - (PW+MO Day\_7) 6.53106229 0.2936731 48  
49 (PW-MO Day\_3) - (PW+MO Day\_3) 5.20342620 0.2936731 48  
50 (PW-MO Day\_3) - (sterile-water Day\_5) 1.87788436 0.2936731 48  
51 (PW-MO Day\_3) - (PW-MO Day\_5) 0.87582540 0.2936731 48  
52 (PW-MO Day\_3) - (PW+MO Day\_5) 5.50487507 0.2936731 48  
53 (PW-MO Day\_3) - (sterile-water Day\_7) 2.74793039 0.2936731 48  
54 (PW-MO Day\_3) - (PW-MO Day\_7) 1.83320035 0.2936731 48  
55 (PW-MO Day\_3) - (PW+MO Day\_7) 6.70818435 0.2936731 48  
56 (PW+MO Day\_3) - (sterile-water Day\_5) -3.32554184 0.2936731 48  
57 (PW+MO Day\_3) - (PW-MO Day\_5) -4.32760080 0.2936731 48  
58 (PW+MO Day\_3) - (PW+MO Day\_5) 0.30144887 0.2936731 48  
59 (PW+MO Day\_3) - (sterile-water Day\_7) -2.45549581 0.2936731 48  
60 (PW+MO Day\_3) - (PW-MO Day\_7) -3.37022585 0.2936731 48  
61 (PW+MO Day\_3) - (PW+MO Day\_7) 1.50475815 0.2936731 48  
62 (sterile-water Day\_5) - (PW-MO Day\_5) -1.00205896 0.2936731 48  
63 (sterile-water Day\_5) - (PW+MO Day\_5) 3.62699071 0.2936731 48  
64 (sterile-water Day\_5) - (sterile-water Day\_7) 0.87004603 0.2936731 48  
65 (sterile-water Day\_5) - (PW-MO Day\_7) -0.04468401 0.2936731 48  
66 (sterile-water Day\_5) - (PW+MO Day\_7) 4.83029999 0.2936731 48  
67 (PW-MO Day\_5) - (PW+MO Day\_5) 4.62904968 0.2936731 48  
68 (PW-MO Day\_5) - (sterile-water Day\_7) 1.87210500 0.2936731 48  
69 (PW-MO Day\_5) - (PW-MO Day\_7) 0.95737495 0.2936731 48  
70 (PW-MO Day\_5) - (PW+MO Day\_7) 5.83235895 0.2936731 48  
71 (PW+MO Day\_5) - (sterile-water Day\_7) -2.75694468 0.2936731 48  
72 (PW+MO Day\_5) - (PW-MO Day\_7) -3.67167472 0.2936731 48  
73 (PW+MO Day\_5) - (PW+MO Day\_7) 1.20330928 0.2936731 48  
74 (sterile-water Day\_7) - (PW-MO Day\_7) -0.91473005 0.2936731 48  
75 (sterile-water Day\_7) - (PW+MO Day\_7) 3.96025396 0.2936731 48  
76 (PW-MO Day\_7) - (PW+MO Day\_7) 4.87498400 0.2936731 48  
77 n Day\_1 - y Day\_1 0.06776878 0.2397830 48  
78 n Day\_1 - n Day\_3 0.31984147 0.2397830 48  
79 n Day\_1 - y Day\_3 -1.82774990 0.2397830 48  
80 n Day\_1 - n Day\_5 0.89827967 0.2397830 48  
81 n Day\_1 - y Day\_5 -0.48749705 0.2397830 48  
82 n Day\_1 - n Day\_7 1.64257839 0.2397830 48  
83 n Day\_1 - y Day\_7 0.78869107 0.2397830 48  
84 y Day\_1 - n Day\_3 0.25207268 0.2397830 48  
85 y Day\_1 - y Day\_3 -1.89551868 0.2397830 48  
86 y Day\_1 - n Day\_5 0.83051089 0.2397830 48  
87 y Day\_1 - y Day\_5 -0.55526584 0.2397830 48  
88 y Day\_1 - n Day\_7 1.57480960 0.2397830 48  
89 y Day\_1 - y Day\_7 0.72092229 0.2397830 48  
90 n Day\_3 - y Day\_3 -2.14759136 0.2397830 48  
91 n Day\_3 - n Day\_5 0.57843820 0.2397830 48  
92 n Day\_3 - y Day\_5 -0.80733852 0.2397830 48  
93 n Day\_3 - n Day\_7 1.32273692 0.2397830 48  
94 n Day\_3 - y Day\_7 0.46884960 0.2397830 48  
95 y Day\_3 - n Day\_5 2.72602956 0.2397830 48  
96 y Day\_3 - y Day\_5 1.34025284 0.2397830 48  
97 y Day\_3 - n Day\_7 3.47032828 0.2397830 48  
98 y Day\_3 - y Day\_7 2.61644097 0.2397830 48  
99 n Day\_5 - y Day\_5 -1.38577672 0.2397830 48  
100 n Day\_5 - n Day\_7 0.74429872 0.2397830 48  
101 n Day\_5 - y Day\_7 -0.10958860 0.2397830 48  
102 y Day\_5 - n Day\_7 2.13007544 0.2397830 48  
103 y Day\_5 - y Day\_7 1.27618812 0.2397830 48  
104 n Day\_7 - y Day\_7 -0.85388732 0.2397830 48  
 t.ratio p.value factor  
1 -4.6465838 1.521359e-04 Day  
2 1.0115286 7.434984e-01 Day  
3 6.9698311 4.856333e-08 Day  
4 5.6581124 4.873649e-06 Day  
5 11.6164149 0.000000e+00 Day  
6 5.9583025 1.709576e-06 Day  
7 -9.0070725 6.923623e-12 TB  
8 -2.3174340 6.290873e-02 WTreat  
9 24.5190568 0.000000e+00 WTreat  
10 26.8364907 0.000000e+00 WTreat  
11 2.4952075 3.673389e-01 Day\*WTreat  
12 6.0871232 1.129690e-05 Day\*WTreat  
13 -5.3259891 1.540442e-04 Day\*WTreat  
14 -5.9291158 1.954465e-05 Day\*WTreat  
15 11.7893163 0.000000e+00 Day\*WTreat  
16 0.4653569 9.999983e-01 Day\*WTreat  
17 -2.9468014 1.573217e-01 Day\*WTreat  
18 12.8157941 0.000000e+00 Day\*WTreat  
19 3.4279917 5.073938e-02 Day\*WTreat  
20 0.3132012 1.000000e+00 Day\*WTreat  
21 16.9132393 0.000000e+00 Day\*WTreat  
22 3.5919157 3.304508e-02 Day\*WTreat  
23 -7.8211966 2.627077e-08 Day\*WTreat  
24 -8.4243233 3.262514e-09 Day\*WTreat  
25 9.2941088 1.677356e-10 Day\*WTreat  
26 -2.0298507 6.716810e-01 Day\*WTreat  
27 -5.4420089 1.040033e-04 Day\*WTreat  
28 10.3205866 2.958744e-12 Day\*WTreat  
29 0.9327842 9.983727e-01 Day\*WTreat  
30 -2.1820063 5.697876e-01 Day\*WTreat  
31 14.4180318 0.000000e+00 Day\*WTreat  
32 -11.4131123 0.000000e+00 Day\*WTreat  
33 -12.0162390 0.000000e+00 Day\*WTreat  
34 5.7021932 4.275279e-05 Day\*WTreat  
35 -5.6217663 5.633470e-05 Day\*WTreat  
36 -9.0339246 4.064197e-10 Day\*WTreat  
37 6.7286710 1.200472e-06 Day\*WTreat  
38 -2.6591315 2.775082e-01 Day\*WTreat  
39 -5.7739220 3.340389e-05 Day\*WTreat  
40 10.8261162 0.000000e+00 Day\*WTreat  
41 -0.6031267 9.999751e-01 Day\*WTreat  
42 17.1153055 0.000000e+00 Day\*WTreat  
43 5.7913460 3.145739e-05 Day\*WTreat  
44 2.3791877 4.388765e-01 Day\*WTreat  
45 18.1417832 0.000000e+00 Day\*WTreat  
46 8.7539808 1.054727e-09 Day\*WTreat  
47 5.6391903 5.307043e-05 Day\*WTreat  
48 22.2392285 0.000000e+00 Day\*WTreat  
49 17.7184322 0.000000e+00 Day\*WTreat  
50 6.3944727 3.868566e-06 Day\*WTreat  
51 2.9823144 1.457799e-01 Day\*WTreat  
52 18.7449099 0.000000e+00 Day\*WTreat  
53 9.3571075 1.353071e-10 Day\*WTreat  
54 6.2423170 6.580768e-06 Day\*WTreat  
55 22.8423552 0.000000e+00 Day\*WTreat  
56 -11.3239595 0.000000e+00 Day\*WTreat  
57 -14.7361178 0.000000e+00 Day\*WTreat  
58 1.0264778 9.962387e-01 Day\*WTreat  
59 -8.3613247 4.051934e-09 Day\*WTreat  
60 -11.4761151 0.000000e+00 Day\*WTreat  
61 5.1239230 3.033969e-04 Day\*WTreat  
62 -3.4121583 5.282930e-02 Day\*WTreat  
63 12.3504373 0.000000e+00 Day\*WTreat  
64 2.9626348 1.520910e-01 Day\*WTreat  
65 -0.1521556 1.000000e+00 Day\*WTreat  
66 16.4478825 0.000000e+00 Day\*WTreat  
67 15.7625955 0.000000e+00 Day\*WTreat  
68 6.3747931 4.144016e-06 Day\*WTreat  
69 3.2600026 7.707520e-02 Day\*WTreat  
70 19.8600408 0.000000e+00 Day\*WTreat  
71 -9.3878025 1.218505e-10 Day\*WTreat  
72 -12.5025929 0.000000e+00 Day\*WTreat  
73 4.0974452 7.896020e-03 Day\*WTreat  
74 -3.1147905 1.085209e-01 Day\*WTreat  
75 13.4852477 0.000000e+00 Day\*WTreat  
76 16.6000381 0.000000e+00 Day\*WTreat  
77 0.2826254 9.999917e-01 Day\*TB  
78 1.3338786 8.811923e-01 Day\*TB  
79 -7.6225150 2.254691e-08 Day\*TB  
80 3.7462184 1.049517e-02 Day\*TB  
81 -2.0330755 4.714340e-01 Day\*TB  
82 6.8502690 3.385799e-07 Day\*TB  
83 3.2891861 3.673700e-02 Day\*TB  
84 1.0512531 9.635870e-01 Day\*TB  
85 -7.9051404 8.416364e-09 Day\*TB  
86 3.4635930 2.312956e-02 Day\*TB  
87 -2.3157010 3.066017e-01 Day\*TB  
88 6.5676436 9.143272e-07 Day\*TB  
89 3.0065607 7.421067e-02 Day\*TB  
90 -8.9563936 2.244819e-10 Day\*TB  
91 2.4123398 2.589734e-01 Day\*TB  
92 -3.3669541 2.996437e-02 Day\*TB  
93 5.5163904 3.559339e-05 Day\*TB  
94 1.9553075 5.214920e-01 Day\*TB  
95 11.3687334 0.000000e+00 Day\*TB  
96 5.5894395 2.768988e-05 Day\*TB  
97 14.4727840 0.000000e+00 Day\*TB  
98 10.9117011 0.000000e+00 Day\*TB  
99 -5.7792939 1.437258e-05 Day\*TB  
100 3.1040506 5.863526e-02 Day\*TB  
101 -0.4570323 9.997851e-01 Day\*TB  
102 8.8833445 2.883955e-10 Day\*TB  
103 5.3222616 6.910324e-05 Day\*TB  
104 -3.5610829 1.770574e-02 Day\*TB

ph2b\_table <- f2b\_all\_tukey\_df %>%  
 dplyr::select(factor, contrast, estimate, SE, df, t.ratio, p.value) %>%  
 gt() %>%  
 # change column names  
 cols\_label(  
 factor = "Comparison",  
 contrast = "Group Comparison",  
 estimate = "Estimate",  
 SE = "Standard Error",  
 df = "Degrees of Freedom",  
 t.ratio = "t-Ratio",  
 p.value = "p-value"  
 ) %>%  
 # update header for table  
 tab\_header(  
 title = "4b Emmeans Post-hoc Test Results"  
 ) %>%  
 # 3 decimal places  
 fmt\_number(  
 columns = c(estimate, SE, t.ratio),  
 decimals = 3  
 ) %>%  
 # scientific number format for values <0.001 in p values  
 fmt\_scientific(  
 columns = c(p.value),  
 decimals = 1,  
 rows = p.value < 0.001  
 ) %>%  
 # 3 decimals for p values >=0.001  
 fmt\_number(  
 columns = c(p.value),  
 decimals = 3,  
 rows = p.value >= 0.001  
 ) %>%  
 #make the headers bold  
 tab\_style(  
 style = list(  
 cell\_text(weight = "bold")  
 ),  
 locations = cells\_column\_labels(everything()))  
  
ph2b\_table

Table 1: 4b Emmeans Post-hoc Test Results

| Comparison | Group Comparison | Estimate | Standard Error | Degrees of Freedom | t-Ratio | p-value |
| --- | --- | --- | --- | --- | --- | --- |
| Day | Day\_1 - Day\_3 | -0.788 | 0.170 | 48 | -4.647 | 1.5 × 10^-4 |
| Day | Day\_1 - Day\_5 | 0.172 | 0.170 | 48 | 1.012 | 0.743 |
| Day | Day\_1 - Day\_7 | 1.182 | 0.170 | 48 | 6.970 | 4.9 × 10^-8 |
| Day | Day\_3 - Day\_5 | 0.959 | 0.170 | 48 | 5.658 | 4.9 × 10^-6 |
| Day | Day\_3 - Day\_7 | 1.970 | 0.170 | 48 | 11.616 | 0.0 |
| Day | Day\_5 - Day\_7 | 1.010 | 0.170 | 48 | 5.958 | 1.7 × 10^-6 |
| TB | n - y | -1.080 | 0.120 | 48 | -9.007 | 6.9 × 10^-12 |
| WTreat | (sterile-water) - (PW-MO) | -0.340 | 0.147 | 48 | -2.317 | 0.063 |
| WTreat | (sterile-water) - (PW+MO) | 3.600 | 0.147 | 48 | 24.519 | 0.0 |
| WTreat | (PW-MO) - (PW+MO) | 3.941 | 0.147 | 48 | 26.836 | 0.0 |
| Day\*WTreat | (sterile-water Day\_1) - (PW-MO Day\_1) | 0.733 | 0.294 | 48 | 2.495 | 0.367 |
| Day\*WTreat | (sterile-water Day\_1) - (PW+MO Day\_1) | 1.788 | 0.294 | 48 | 6.087 | 1.1 × 10^-5 |
| Day\*WTreat | (sterile-water Day\_1) - (sterile-water Day\_3) | -1.564 | 0.294 | 48 | -5.326 | 1.5 × 10^-4 |
| Day\*WTreat | (sterile-water Day\_1) - (PW-MO Day\_3) | -1.741 | 0.294 | 48 | -5.929 | 2.0 × 10^-5 |
| Day\*WTreat | (sterile-water Day\_1) - (PW+MO Day\_3) | 3.462 | 0.294 | 48 | 11.789 | 0.0 |
| Day\*WTreat | (sterile-water Day\_1) - (sterile-water Day\_5) | 0.137 | 0.294 | 48 | 0.465 | 1.000 |
| Day\*WTreat | (sterile-water Day\_1) - (PW-MO Day\_5) | -0.865 | 0.294 | 48 | -2.947 | 0.157 |
| Day\*WTreat | (sterile-water Day\_1) - (PW+MO Day\_5) | 3.764 | 0.294 | 48 | 12.816 | 0.0 |
| Day\*WTreat | (sterile-water Day\_1) - (sterile-water Day\_7) | 1.007 | 0.294 | 48 | 3.428 | 0.051 |
| Day\*WTreat | (sterile-water Day\_1) - (PW-MO Day\_7) | 0.092 | 0.294 | 48 | 0.313 | 1.000 |
| Day\*WTreat | (sterile-water Day\_1) - (PW+MO Day\_7) | 4.967 | 0.294 | 48 | 16.913 | 0.0 |
| Day\*WTreat | (PW-MO Day\_1) - (PW+MO Day\_1) | 1.055 | 0.294 | 48 | 3.592 | 0.033 |
| Day\*WTreat | (PW-MO Day\_1) - (sterile-water Day\_3) | -2.297 | 0.294 | 48 | -7.821 | 2.6 × 10^-8 |
| Day\*WTreat | (PW-MO Day\_1) - (PW-MO Day\_3) | -2.474 | 0.294 | 48 | -8.424 | 3.3 × 10^-9 |
| Day\*WTreat | (PW-MO Day\_1) - (PW+MO Day\_3) | 2.729 | 0.294 | 48 | 9.294 | 1.7 × 10^-10 |
| Day\*WTreat | (PW-MO Day\_1) - (sterile-water Day\_5) | -0.596 | 0.294 | 48 | -2.030 | 0.672 |
| Day\*WTreat | (PW-MO Day\_1) - (PW-MO Day\_5) | -1.598 | 0.294 | 48 | -5.442 | 1.0 × 10^-4 |
| Day\*WTreat | (PW-MO Day\_1) - (PW+MO Day\_5) | 3.031 | 0.294 | 48 | 10.321 | 3.0 × 10^-12 |
| Day\*WTreat | (PW-MO Day\_1) - (sterile-water Day\_7) | 0.274 | 0.294 | 48 | 0.933 | 0.998 |
| Day\*WTreat | (PW-MO Day\_1) - (PW-MO Day\_7) | -0.641 | 0.294 | 48 | -2.182 | 0.570 |
| Day\*WTreat | (PW-MO Day\_1) - (PW+MO Day\_7) | 4.234 | 0.294 | 48 | 14.418 | 0.0 |
| Day\*WTreat | (PW+MO Day\_1) - (sterile-water Day\_3) | -3.352 | 0.294 | 48 | -11.413 | 0.0 |
| Day\*WTreat | (PW+MO Day\_1) - (PW-MO Day\_3) | -3.529 | 0.294 | 48 | -12.016 | 0.0 |
| Day\*WTreat | (PW+MO Day\_1) - (PW+MO Day\_3) | 1.675 | 0.294 | 48 | 5.702 | 4.3 × 10^-5 |
| Day\*WTreat | (PW+MO Day\_1) - (sterile-water Day\_5) | -1.651 | 0.294 | 48 | -5.622 | 5.6 × 10^-5 |
| Day\*WTreat | (PW+MO Day\_1) - (PW-MO Day\_5) | -2.653 | 0.294 | 48 | -9.034 | 4.1 × 10^-10 |
| Day\*WTreat | (PW+MO Day\_1) - (PW+MO Day\_5) | 1.976 | 0.294 | 48 | 6.729 | 1.2 × 10^-6 |
| Day\*WTreat | (PW+MO Day\_1) - (sterile-water Day\_7) | -0.781 | 0.294 | 48 | -2.659 | 0.278 |
| Day\*WTreat | (PW+MO Day\_1) - (PW-MO Day\_7) | -1.696 | 0.294 | 48 | -5.774 | 3.3 × 10^-5 |
| Day\*WTreat | (PW+MO Day\_1) - (PW+MO Day\_7) | 3.179 | 0.294 | 48 | 10.826 | 0.0 |
| Day\*WTreat | (sterile-water Day\_3) - (PW-MO Day\_3) | -0.177 | 0.294 | 48 | -0.603 | 1.000 |
| Day\*WTreat | (sterile-water Day\_3) - (PW+MO Day\_3) | 5.026 | 0.294 | 48 | 17.115 | 0.0 |
| Day\*WTreat | (sterile-water Day\_3) - (sterile-water Day\_5) | 1.701 | 0.294 | 48 | 5.791 | 3.1 × 10^-5 |
| Day\*WTreat | (sterile-water Day\_3) - (PW-MO Day\_5) | 0.699 | 0.294 | 48 | 2.379 | 0.439 |
| Day\*WTreat | (sterile-water Day\_3) - (PW+MO Day\_5) | 5.328 | 0.294 | 48 | 18.142 | 0.0 |
| Day\*WTreat | (sterile-water Day\_3) - (sterile-water Day\_7) | 2.571 | 0.294 | 48 | 8.754 | 1.1 × 10^-9 |
| Day\*WTreat | (sterile-water Day\_3) - (PW-MO Day\_7) | 1.656 | 0.294 | 48 | 5.639 | 5.3 × 10^-5 |
| Day\*WTreat | (sterile-water Day\_3) - (PW+MO Day\_7) | 6.531 | 0.294 | 48 | 22.239 | 0.0 |
| Day\*WTreat | (PW-MO Day\_3) - (PW+MO Day\_3) | 5.203 | 0.294 | 48 | 17.718 | 0.0 |
| Day\*WTreat | (PW-MO Day\_3) - (sterile-water Day\_5) | 1.878 | 0.294 | 48 | 6.394 | 3.9 × 10^-6 |
| Day\*WTreat | (PW-MO Day\_3) - (PW-MO Day\_5) | 0.876 | 0.294 | 48 | 2.982 | 0.146 |
| Day\*WTreat | (PW-MO Day\_3) - (PW+MO Day\_5) | 5.505 | 0.294 | 48 | 18.745 | 0.0 |
| Day\*WTreat | (PW-MO Day\_3) - (sterile-water Day\_7) | 2.748 | 0.294 | 48 | 9.357 | 1.4 × 10^-10 |
| Day\*WTreat | (PW-MO Day\_3) - (PW-MO Day\_7) | 1.833 | 0.294 | 48 | 6.242 | 6.6 × 10^-6 |
| Day\*WTreat | (PW-MO Day\_3) - (PW+MO Day\_7) | 6.708 | 0.294 | 48 | 22.842 | 0.0 |
| Day\*WTreat | (PW+MO Day\_3) - (sterile-water Day\_5) | -3.326 | 0.294 | 48 | -11.324 | 0.0 |
| Day\*WTreat | (PW+MO Day\_3) - (PW-MO Day\_5) | -4.328 | 0.294 | 48 | -14.736 | 0.0 |
| Day\*WTreat | (PW+MO Day\_3) - (PW+MO Day\_5) | 0.301 | 0.294 | 48 | 1.026 | 0.996 |
| Day\*WTreat | (PW+MO Day\_3) - (sterile-water Day\_7) | -2.455 | 0.294 | 48 | -8.361 | 4.1 × 10^-9 |
| Day\*WTreat | (PW+MO Day\_3) - (PW-MO Day\_7) | -3.370 | 0.294 | 48 | -11.476 | 0.0 |
| Day\*WTreat | (PW+MO Day\_3) - (PW+MO Day\_7) | 1.505 | 0.294 | 48 | 5.124 | 3.0 × 10^-4 |
| Day\*WTreat | (sterile-water Day\_5) - (PW-MO Day\_5) | -1.002 | 0.294 | 48 | -3.412 | 0.053 |
| Day\*WTreat | (sterile-water Day\_5) - (PW+MO Day\_5) | 3.627 | 0.294 | 48 | 12.350 | 0.0 |
| Day\*WTreat | (sterile-water Day\_5) - (sterile-water Day\_7) | 0.870 | 0.294 | 48 | 2.963 | 0.152 |
| Day\*WTreat | (sterile-water Day\_5) - (PW-MO Day\_7) | -0.045 | 0.294 | 48 | -0.152 | 1.000 |
| Day\*WTreat | (sterile-water Day\_5) - (PW+MO Day\_7) | 4.830 | 0.294 | 48 | 16.448 | 0.0 |
| Day\*WTreat | (PW-MO Day\_5) - (PW+MO Day\_5) | 4.629 | 0.294 | 48 | 15.763 | 0.0 |
| Day\*WTreat | (PW-MO Day\_5) - (sterile-water Day\_7) | 1.872 | 0.294 | 48 | 6.375 | 4.1 × 10^-6 |
| Day\*WTreat | (PW-MO Day\_5) - (PW-MO Day\_7) | 0.957 | 0.294 | 48 | 3.260 | 0.077 |
| Day\*WTreat | (PW-MO Day\_5) - (PW+MO Day\_7) | 5.832 | 0.294 | 48 | 19.860 | 0.0 |
| Day\*WTreat | (PW+MO Day\_5) - (sterile-water Day\_7) | -2.757 | 0.294 | 48 | -9.388 | 1.2 × 10^-10 |
| Day\*WTreat | (PW+MO Day\_5) - (PW-MO Day\_7) | -3.672 | 0.294 | 48 | -12.503 | 0.0 |
| Day\*WTreat | (PW+MO Day\_5) - (PW+MO Day\_7) | 1.203 | 0.294 | 48 | 4.097 | 0.008 |
| Day\*WTreat | (sterile-water Day\_7) - (PW-MO Day\_7) | -0.915 | 0.294 | 48 | -3.115 | 0.109 |
| Day\*WTreat | (sterile-water Day\_7) - (PW+MO Day\_7) | 3.960 | 0.294 | 48 | 13.485 | 0.0 |
| Day\*WTreat | (PW-MO Day\_7) - (PW+MO Day\_7) | 4.875 | 0.294 | 48 | 16.600 | 0.0 |
| Day\*TB | n Day\_1 - y Day\_1 | 0.068 | 0.240 | 48 | 0.283 | 1.000 |
| Day\*TB | n Day\_1 - n Day\_3 | 0.320 | 0.240 | 48 | 1.334 | 0.881 |
| Day\*TB | n Day\_1 - y Day\_3 | -1.828 | 0.240 | 48 | -7.623 | 2.3 × 10^-8 |
| Day\*TB | n Day\_1 - n Day\_5 | 0.898 | 0.240 | 48 | 3.746 | 0.010 |
| Day\*TB | n Day\_1 - y Day\_5 | -0.487 | 0.240 | 48 | -2.033 | 0.471 |
| Day\*TB | n Day\_1 - n Day\_7 | 1.643 | 0.240 | 48 | 6.850 | 3.4 × 10^-7 |
| Day\*TB | n Day\_1 - y Day\_7 | 0.789 | 0.240 | 48 | 3.289 | 0.037 |
| Day\*TB | y Day\_1 - n Day\_3 | 0.252 | 0.240 | 48 | 1.051 | 0.964 |
| Day\*TB | y Day\_1 - y Day\_3 | -1.896 | 0.240 | 48 | -7.905 | 8.4 × 10^-9 |
| Day\*TB | y Day\_1 - n Day\_5 | 0.831 | 0.240 | 48 | 3.464 | 0.023 |
| Day\*TB | y Day\_1 - y Day\_5 | -0.555 | 0.240 | 48 | -2.316 | 0.307 |
| Day\*TB | y Day\_1 - n Day\_7 | 1.575 | 0.240 | 48 | 6.568 | 9.1 × 10^-7 |
| Day\*TB | y Day\_1 - y Day\_7 | 0.721 | 0.240 | 48 | 3.007 | 0.074 |
| Day\*TB | n Day\_3 - y Day\_3 | -2.148 | 0.240 | 48 | -8.956 | 2.2 × 10^-10 |
| Day\*TB | n Day\_3 - n Day\_5 | 0.578 | 0.240 | 48 | 2.412 | 0.259 |
| Day\*TB | n Day\_3 - y Day\_5 | -0.807 | 0.240 | 48 | -3.367 | 0.030 |
| Day\*TB | n Day\_3 - n Day\_7 | 1.323 | 0.240 | 48 | 5.516 | 3.6 × 10^-5 |
| Day\*TB | n Day\_3 - y Day\_7 | 0.469 | 0.240 | 48 | 1.955 | 0.521 |
| Day\*TB | y Day\_3 - n Day\_5 | 2.726 | 0.240 | 48 | 11.369 | 0.0 |
| Day\*TB | y Day\_3 - y Day\_5 | 1.340 | 0.240 | 48 | 5.589 | 2.8 × 10^-5 |
| Day\*TB | y Day\_3 - n Day\_7 | 3.470 | 0.240 | 48 | 14.473 | 0.0 |
| Day\*TB | y Day\_3 - y Day\_7 | 2.616 | 0.240 | 48 | 10.912 | 0.0 |
| Day\*TB | n Day\_5 - y Day\_5 | -1.386 | 0.240 | 48 | -5.779 | 1.4 × 10^-5 |
| Day\*TB | n Day\_5 - n Day\_7 | 0.744 | 0.240 | 48 | 3.104 | 0.059 |
| Day\*TB | n Day\_5 - y Day\_7 | -0.110 | 0.240 | 48 | -0.457 | 1.000 |
| Day\*TB | y Day\_5 - n Day\_7 | 2.130 | 0.240 | 48 | 8.883 | 2.9 × 10^-10 |
| Day\*TB | y Day\_5 - y Day\_7 | 1.276 | 0.240 | 48 | 5.322 | 6.9 × 10^-5 |
| Day\*TB | n Day\_7 - y Day\_7 | -0.854 | 0.240 | 48 | -3.561 | 0.018 |