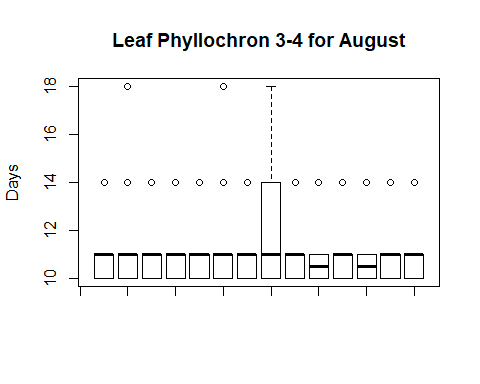
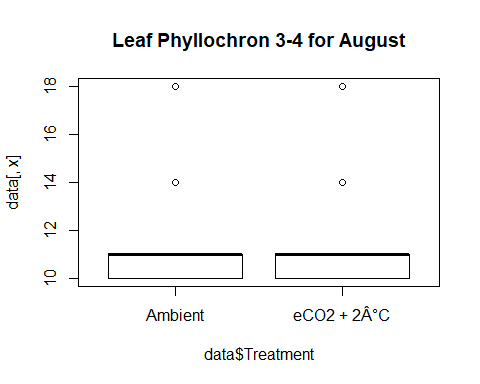
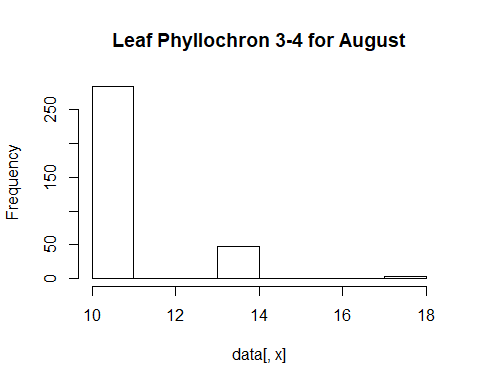
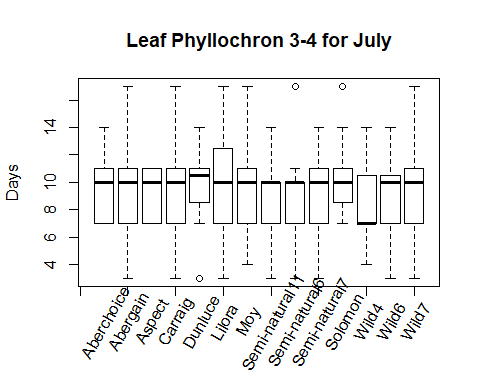
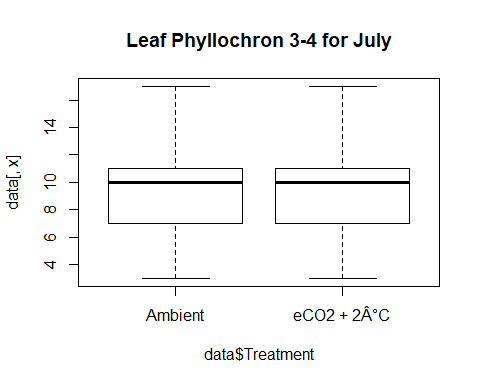
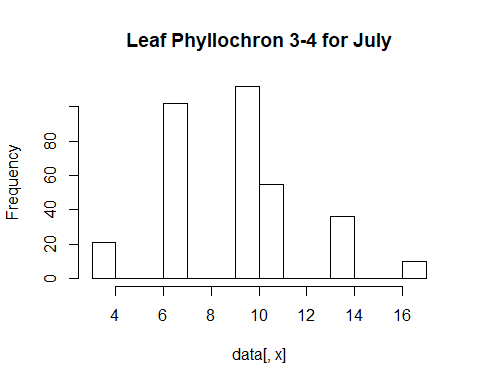
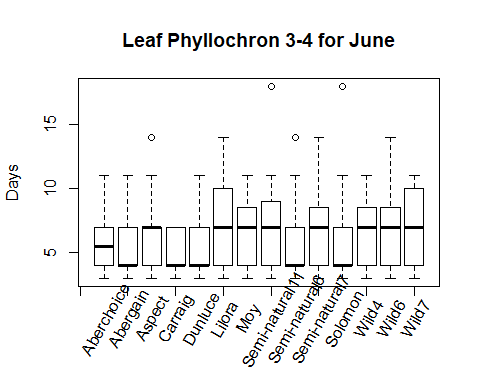
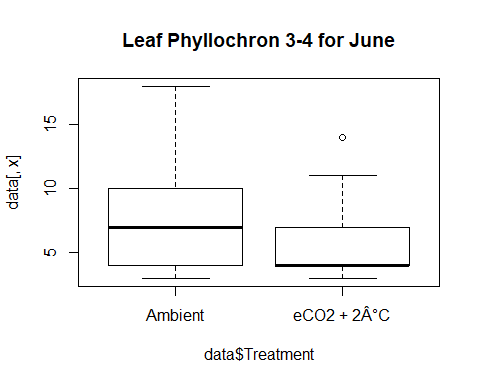
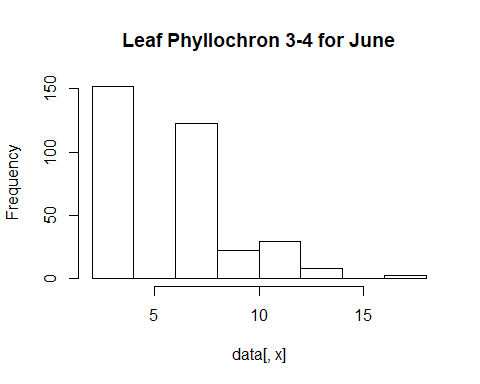
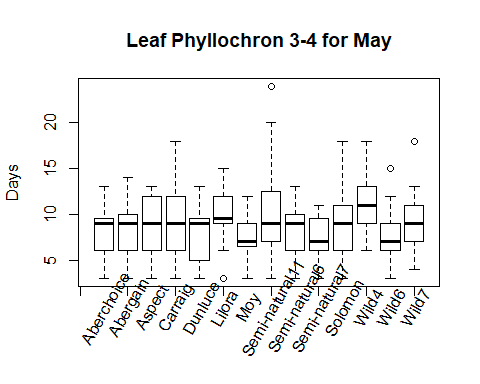
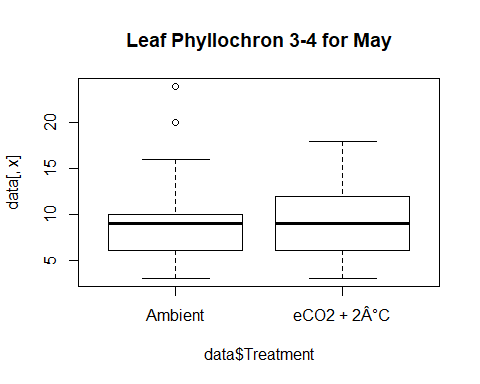
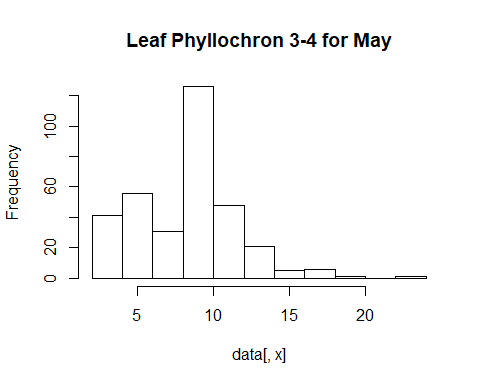
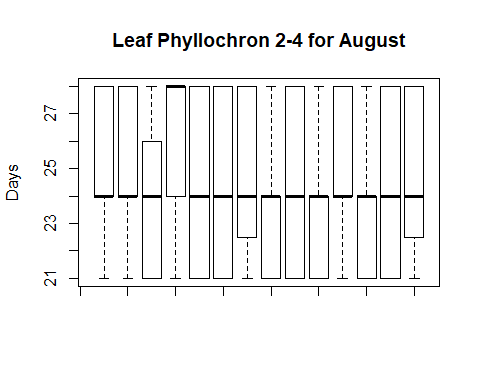
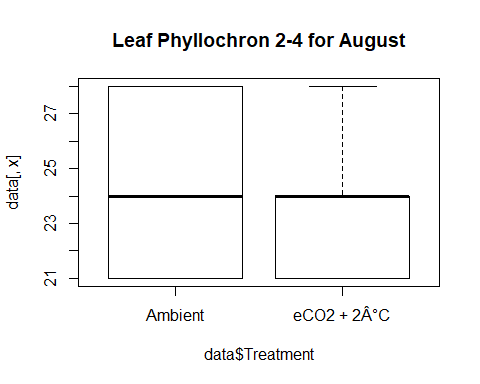
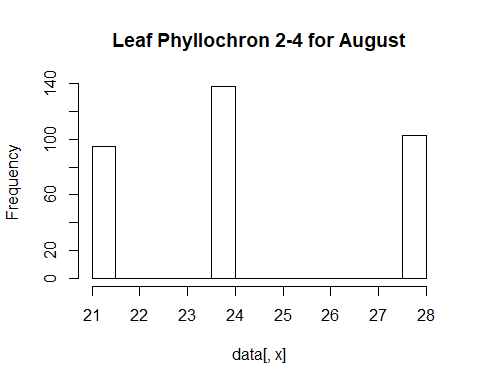
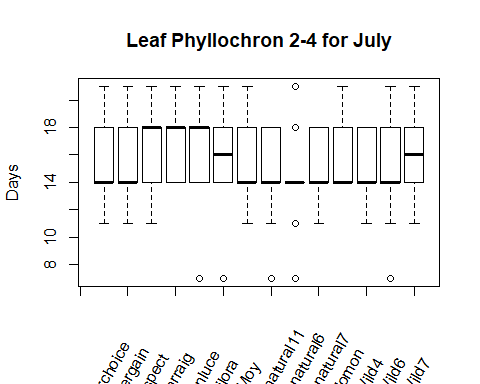
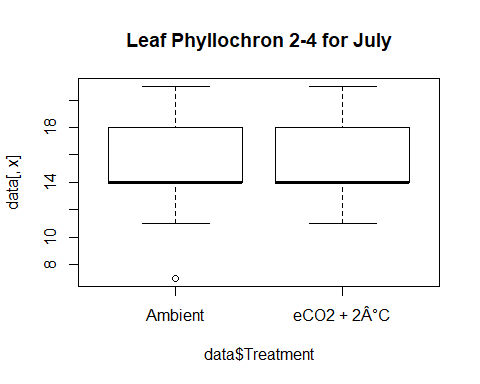
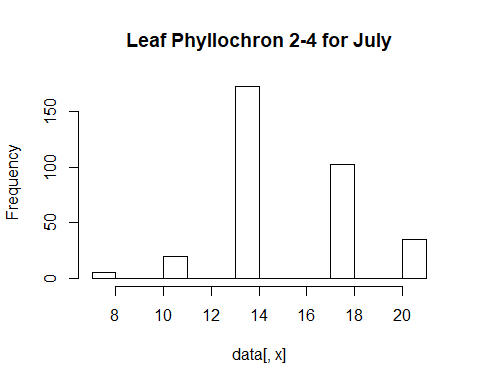
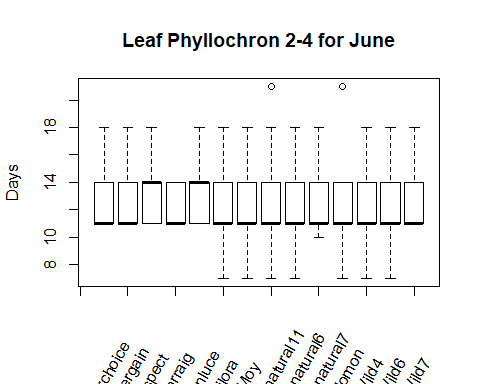
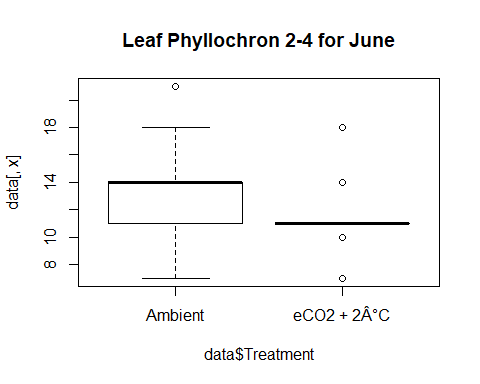
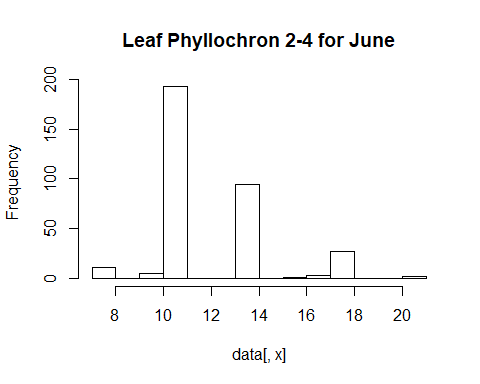
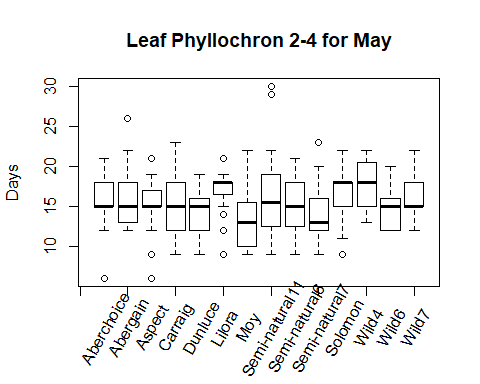
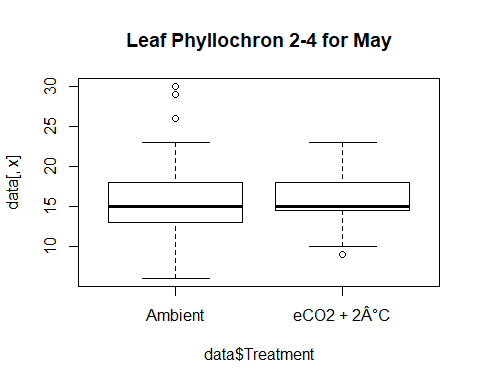
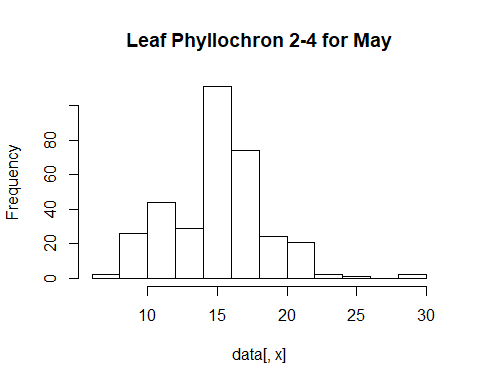
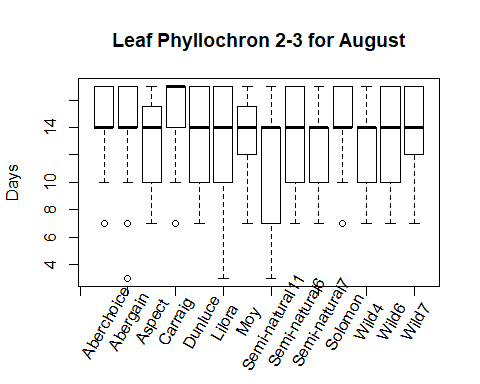
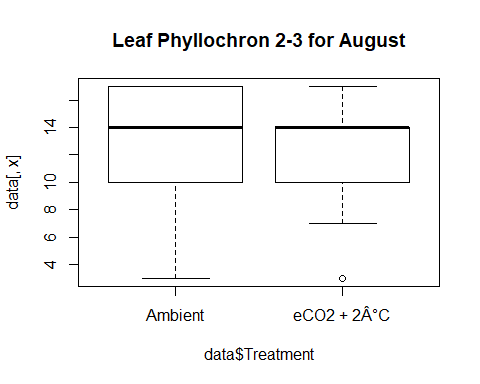
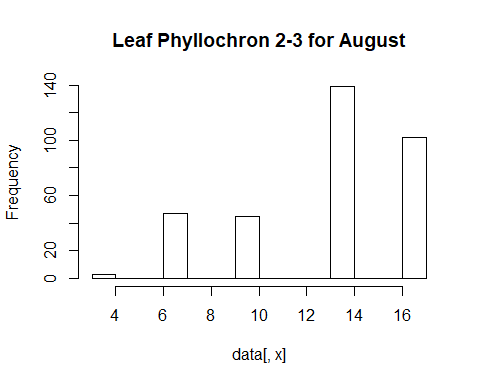
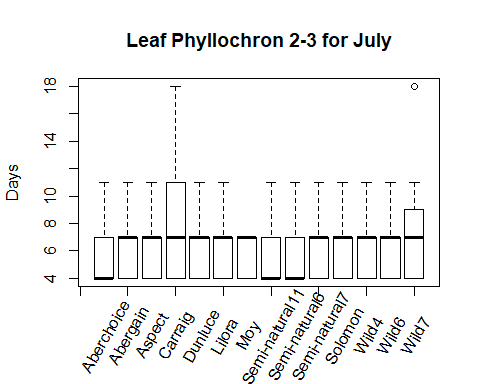
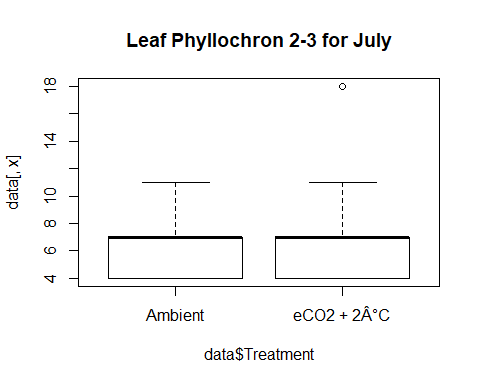
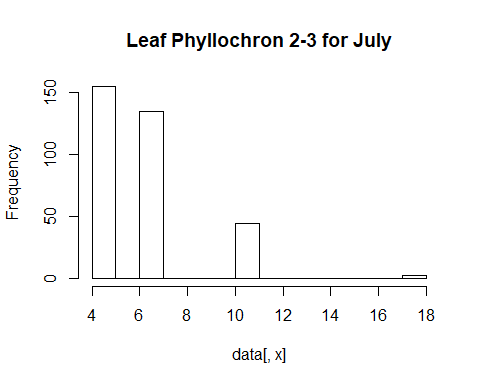
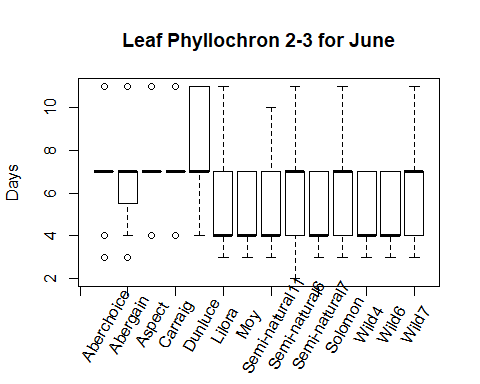
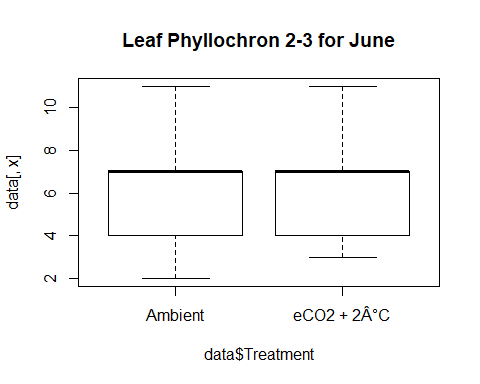
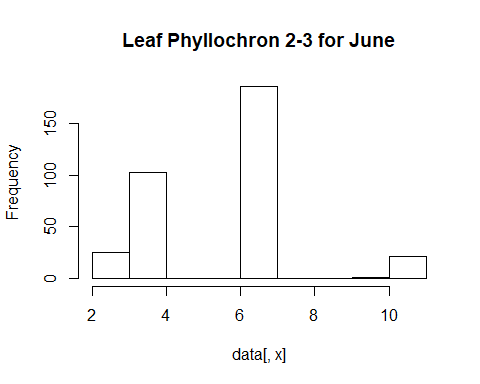
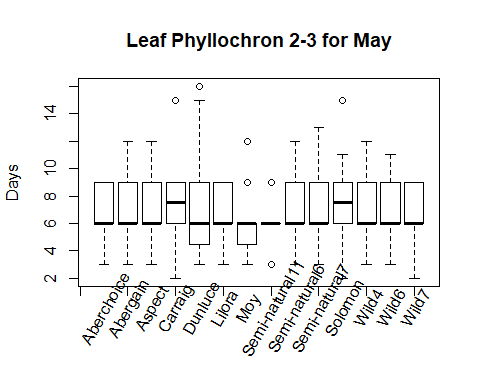
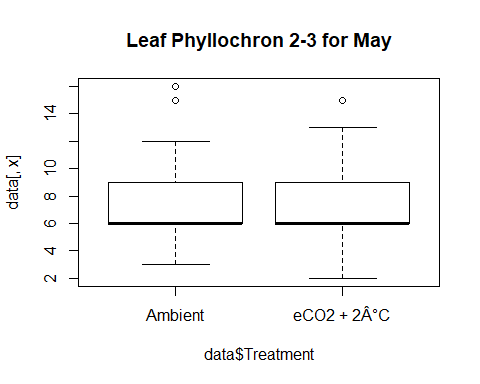
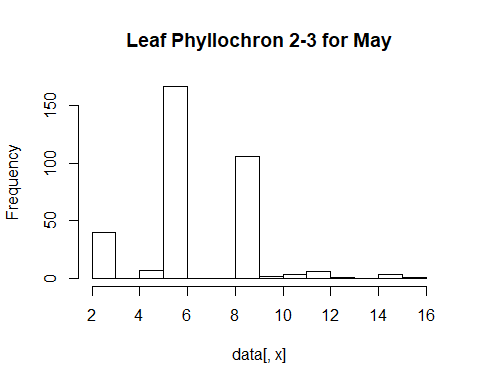
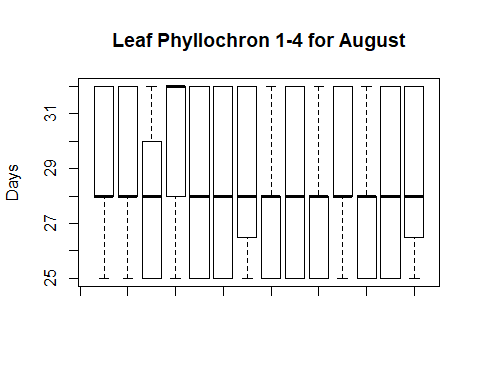
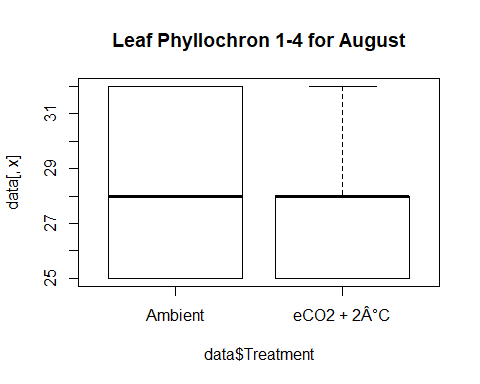
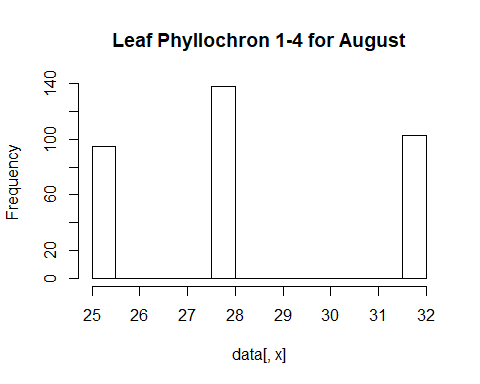
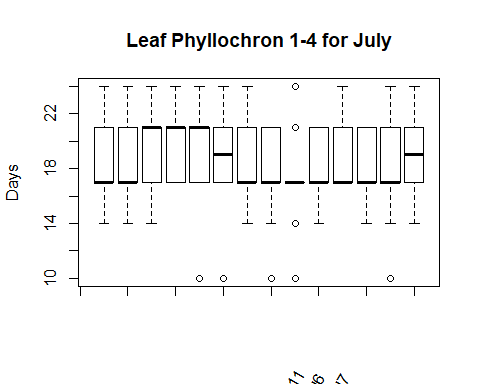
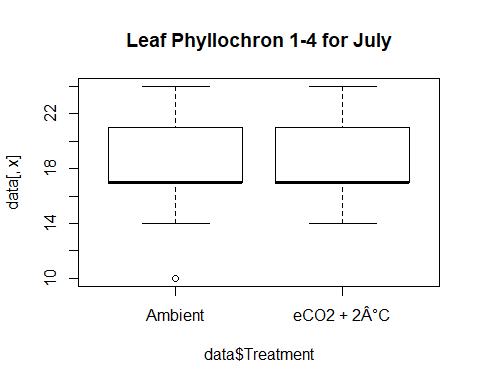
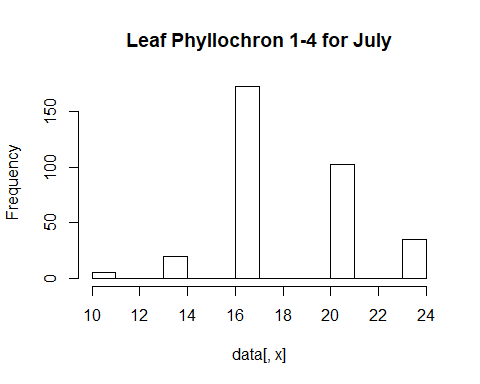
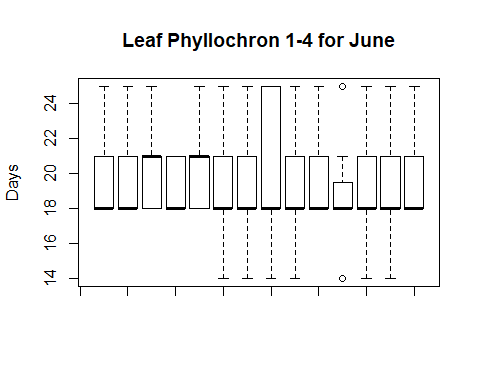
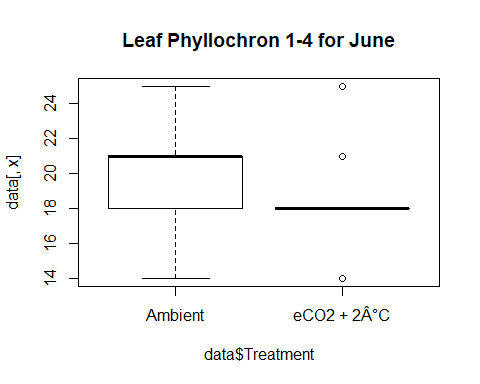
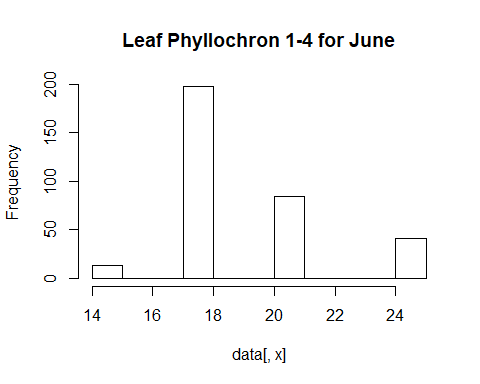
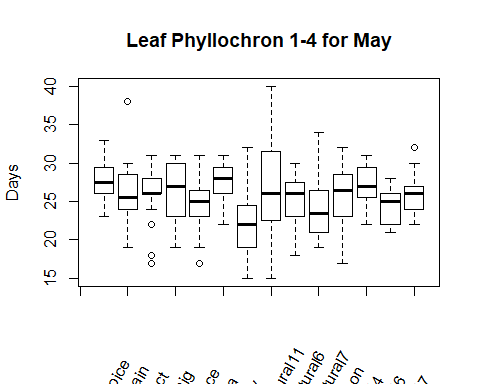
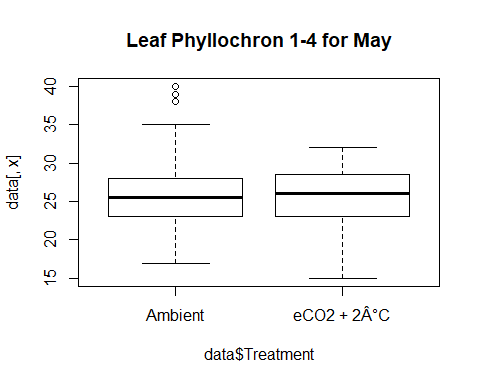
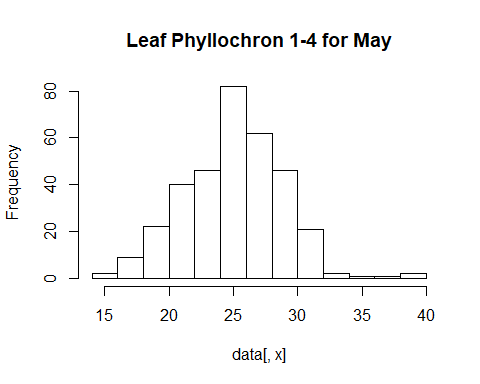
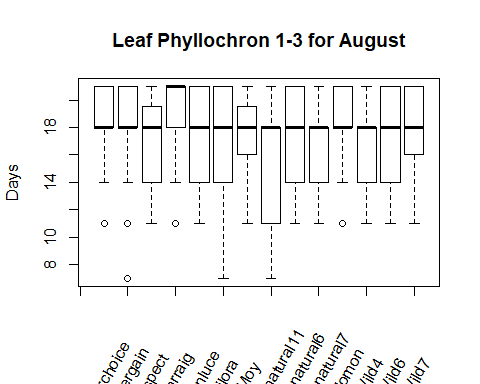
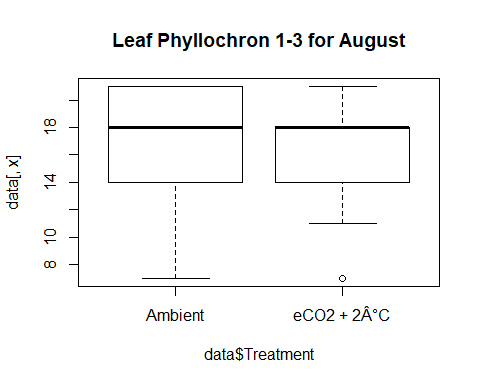
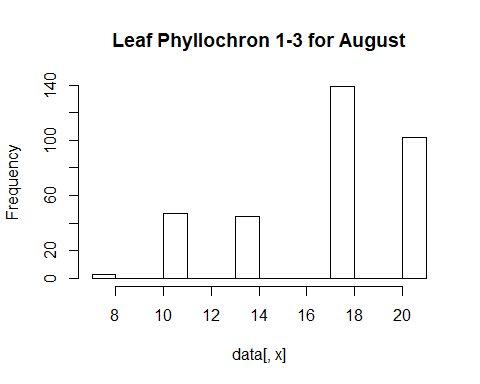
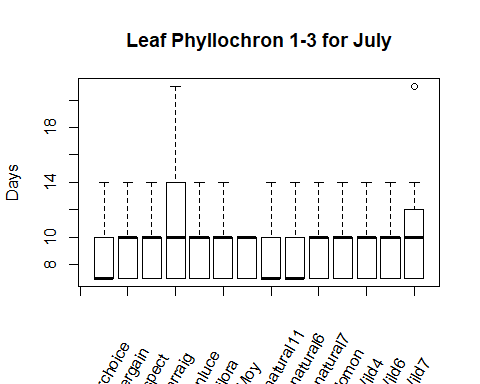
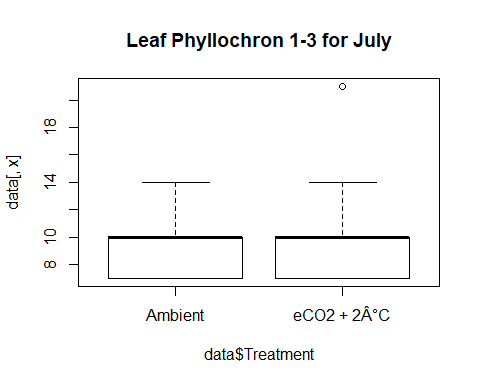
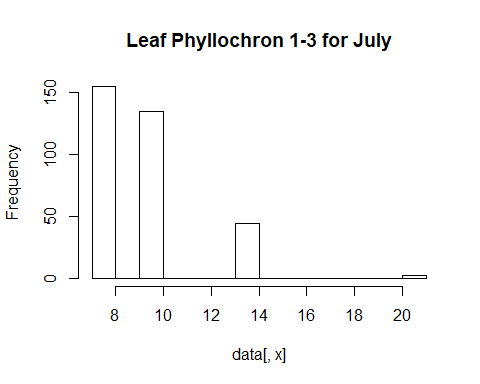
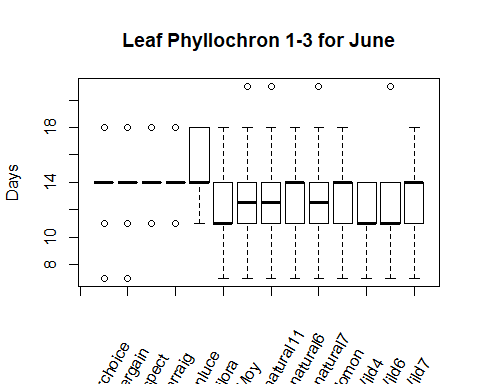
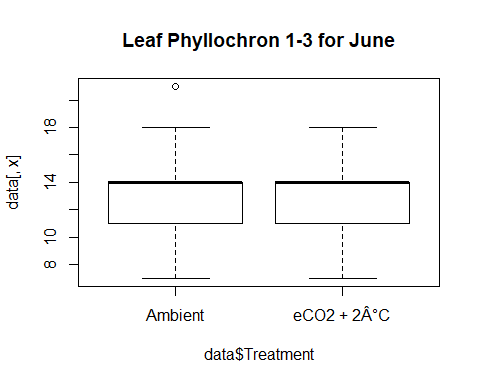
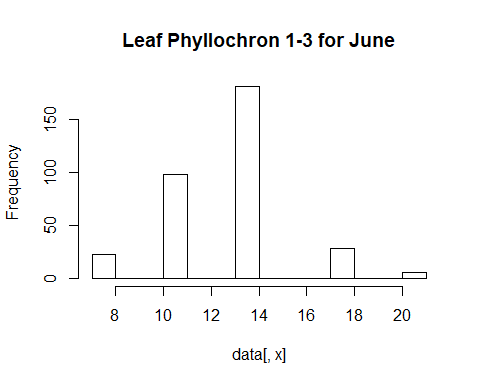
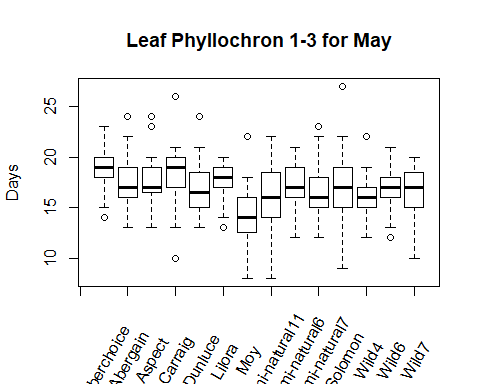
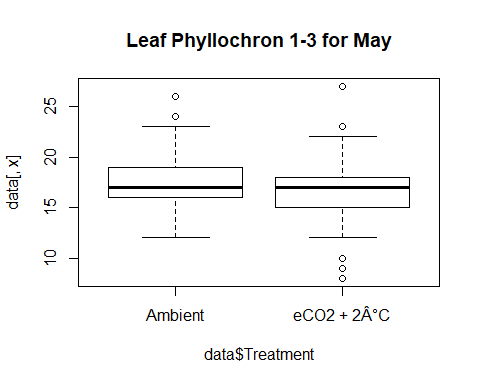
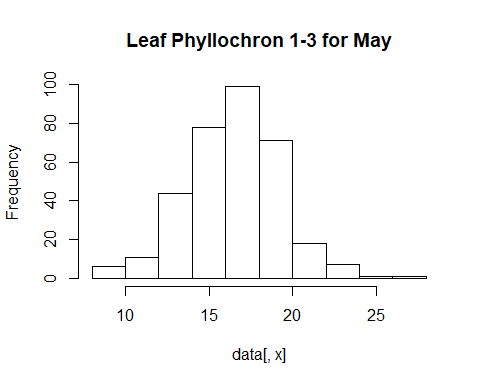
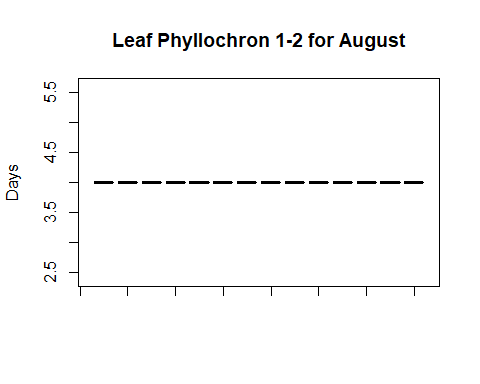
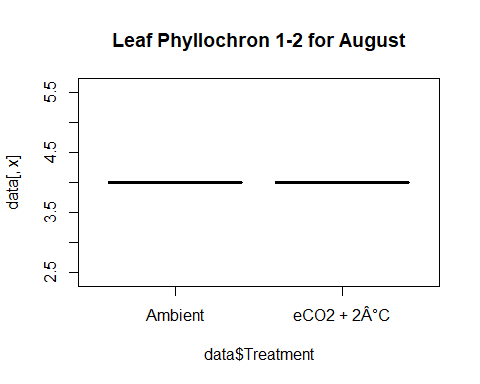
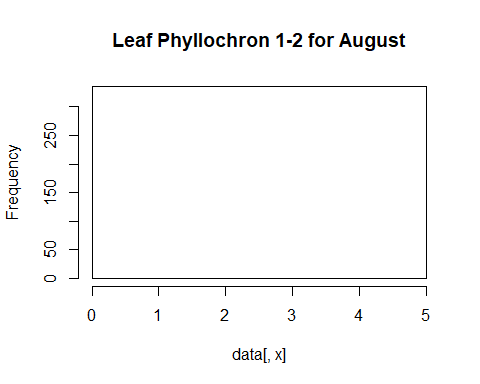
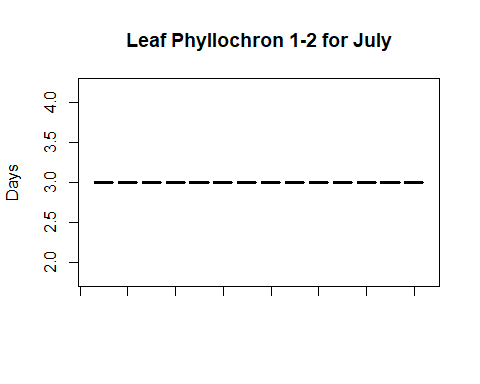
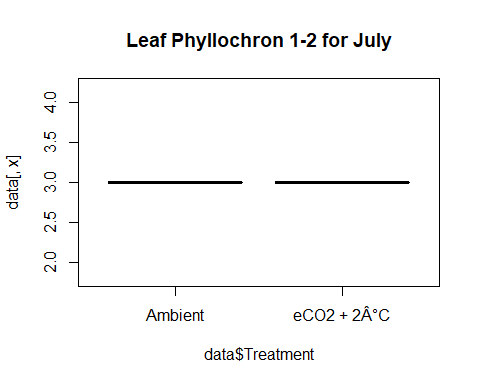
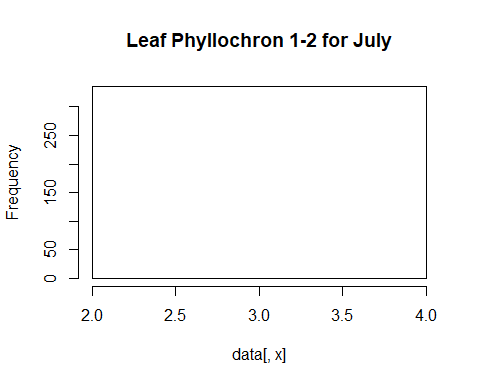
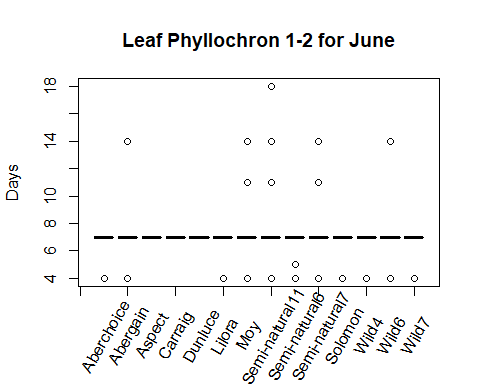
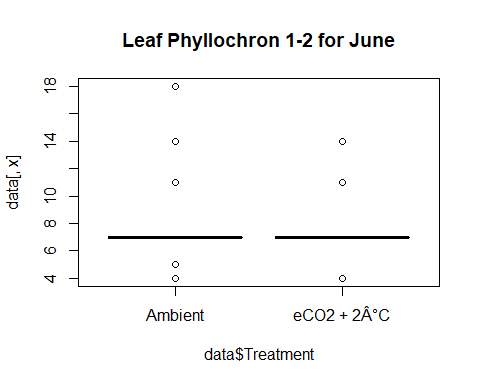
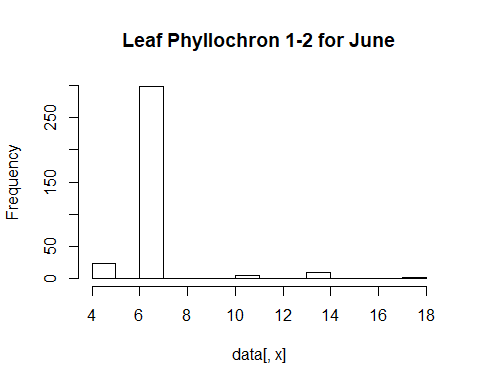
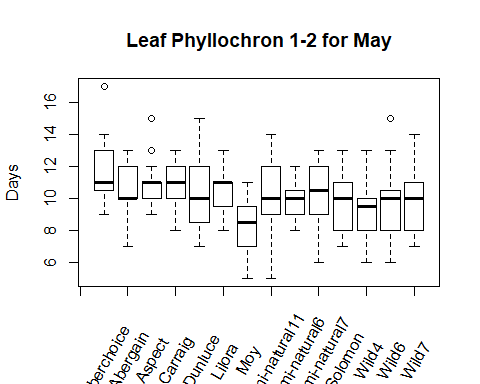
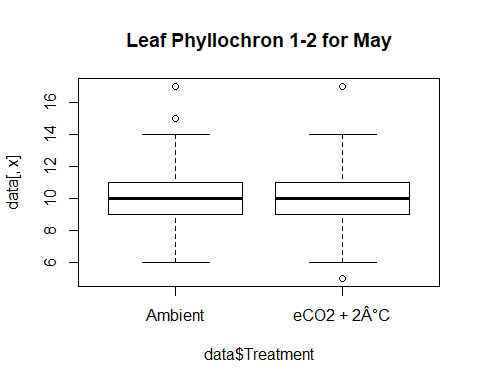
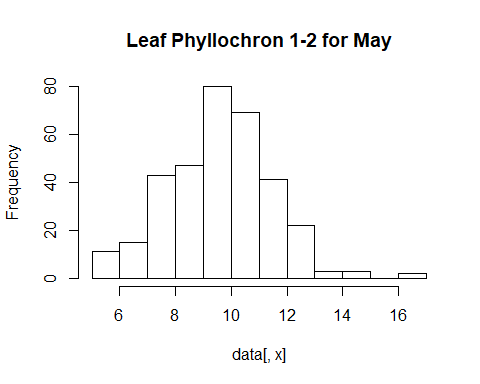
Phyllochron\_data

Dana Looschelders

30 4 2020

## Data Exploration

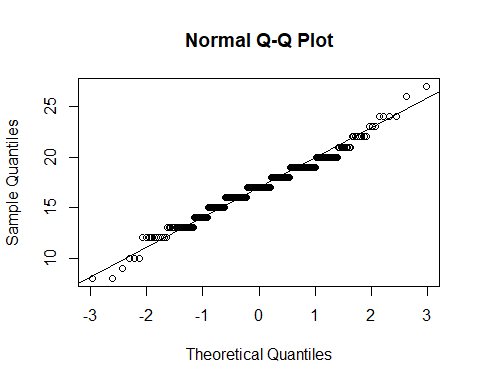
for (i in 1:length(list\_phyllo)) {  
 name\_phyllo=names(list\_phyllo[i])  
 data=list\_phyllo[[i]]  
 for (x in 5:8) {  
 name\_month=names(data[x])  
 #histogram for phyllochron values  
 hist(data[,x], main=paste(name\_phyllo, "for", name\_month))  
 #boxplot for treatment  
 boxplot(data[,x]~data$Treatment, main=paste(name\_phyllo, "for", name\_month))  
 #boxplot for Variety with display of names as labels  
 labels=unique(data$Variety)  
 boxplot(data[,x]~data$Variety,   
 main=paste(name\_phyllo, "for", name\_month),  
 ylab="Days",  
 xaxt = "n", xlab = "")  
 axis(1, labels = FALSE)  
 # Plot x labs at default x position  
 text(x=labels,y = par("usr")[1] - 0.1, srt = 60, adj = 0.5,  
 labels = labels, xpd = TRUE)  
 }  
}



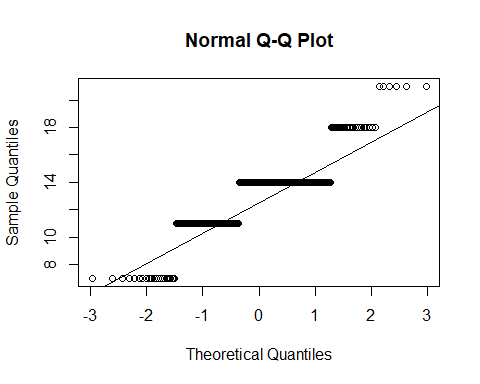
## Normality Test and Significance tests

for (i in 2:length(list\_phyllo)) {  
 name\_phyllo=names(list\_phyllo[i])  
 data=list\_phyllo[[i]]  
 for (x in 5:8) {  
 name\_month=names(data[x])  
 print(paste(name\_phyllo, "for", name\_month))  
 qqnorm(data[,x])  
 qqline(data[,x])  
 print(shapiro.test(data[,x]))  
 test.shapiro=shapiro.test(data[,x])  
 if(test.shapiro[[2]]<0.05){  
 print("Based on shapiro test normality cannot be assumed")  
 print(wilcox.test(data[,x]~data$Treatment))  
 print(kruskal.test(data[,x]~data$Variety))  
 test.kruskal=kruskal.test(data[,x]~data$Variety)  
 if(test.kruskal[[3]]>0.05){  
 print("As the Kruskal test is significant a posthoc test will be performed")  
 print(posthoc.kruskal.nemenyi.test(data[,x]~data$Variety))  
 } else {}  
 } else {}  
 }  
}

## [1] "Leaf Phyllochron 1-3 for May"



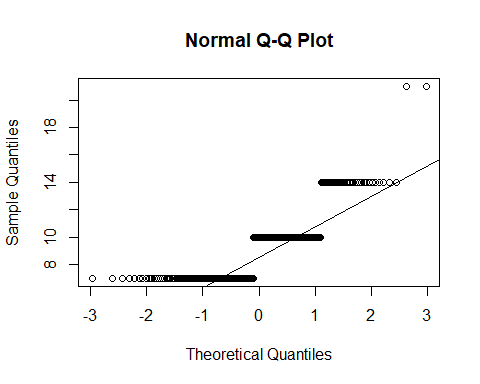
##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.98095, p-value = 0.0001971  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 15928, p-value = 0.03996  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 51.326, df = 13, p-value = 1.763e-06  
##   
## [1] "Leaf Phyllochron 1-3 for June"



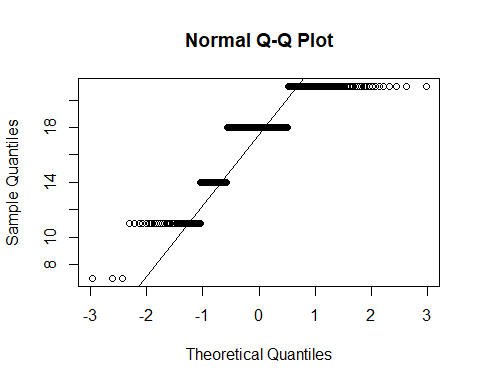
##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.83969, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 12574, p-value = 0.0562  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 37.395, df = 13, p-value = 0.0003592  
##   
## [1] "Leaf Phyllochron 1-3 for July"

##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.75524, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 13668, p-value = 0.5852  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 9.5556, df = 13, p-value = 0.7298  
##   
## [1] "As the Kruskal test is significant a posthoc test will be performed"

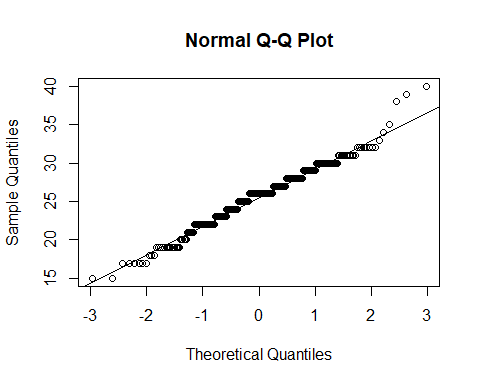
## Warning in posthoc.kruskal.nemenyi.test.default(c(7L, 7L, 10L, 10L, 7L, : Ties  
## are present, p-values are not corrected.



##   
## Pairwise comparisons using Tukey and Kramer (Nemenyi) test   
## with Tukey-Dist approximation for independent samples   
##   
## data: data[, x] by data$Variety   
##   
## Aberchoice Abergain Aspect Carraig Dunluce Lilora Moy   
## Abergain 1.00 - - - - - -   
## Aspect 0.89 1.00 - - - - -   
## Carraig 1.00 1.00 1.00 - - - -   
## Dunluce 1.00 1.00 1.00 1.00 - - -   
## Lilora 1.00 1.00 1.00 1.00 1.00 - -   
## Moy 1.00 1.00 0.96 1.00 1.00 1.00 -   
## Semi-natural11 1.00 1.00 0.72 0.97 0.99 1.00 1.00  
## Semi-natural6 1.00 1.00 0.92 1.00 1.00 1.00 1.00  
## Semi-natural7 1.00 1.00 0.99 1.00 1.00 1.00 1.00  
## Solomon 1.00 1.00 1.00 1.00 1.00 1.00 1.00  
## Wild4 1.00 1.00 1.00 1.00 1.00 1.00 1.00  
## Wild6 1.00 1.00 1.00 1.00 1.00 1.00 1.00  
## Wild7 0.99 1.00 1.00 1.00 1.00 1.00 1.00  
## Semi-natural11 Semi-natural6 Semi-natural7 Solomon Wild4 Wild6  
## Abergain - - - - - -   
## Aspect - - - - - -   
## Carraig - - - - - -   
## Dunluce - - - - - -   
## Lilora - - - - - -   
## Moy - - - - - -   
## Semi-natural11 - - - - - -   
## Semi-natural6 1.00 - - - - -   
## Semi-natural7 1.00 1.00 - - - -   
## Solomon 1.00 1.00 1.00 - - -   
## Wild4 1.00 1.00 1.00 1.00 - -   
## Wild6 1.00 1.00 1.00 1.00 1.00 -   
## Wild7 0.95 1.00 1.00 1.00 1.00 1.00   
##   
## P value adjustment method: none   
## [1] "Leaf Phyllochron 1-3 for August"



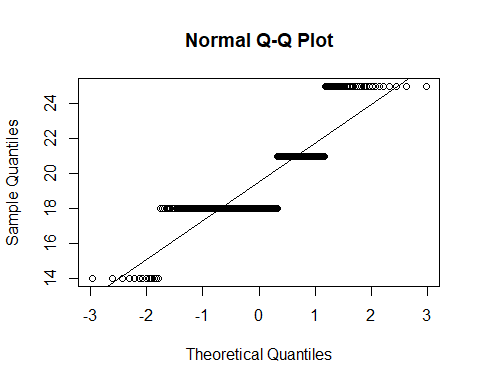
##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.82829, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 15730, p-value = 0.05503  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 23.208, df = 13, p-value = 0.03925  
##   
## [1] "Leaf Phyllochron 1-4 for May"



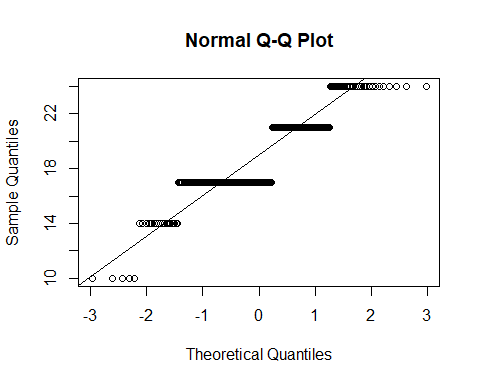
##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.9803, p-value = 0.0001457  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 13071, p-value = 0.2403  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 49.865, df = 13, p-value = 3.145e-06  
##   
## [1] "Leaf Phyllochron 1-4 for June"

##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.77011, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 19341, p-value = 2.763e-11  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 14.025, df = 13, p-value = 0.3721  
##   
## [1] "As the Kruskal test is significant a posthoc test will be performed"

## Warning in posthoc.kruskal.nemenyi.test.default(c(25L, 21L, 21L, 18L, 21L, :  
## Ties are present, p-values are not corrected.



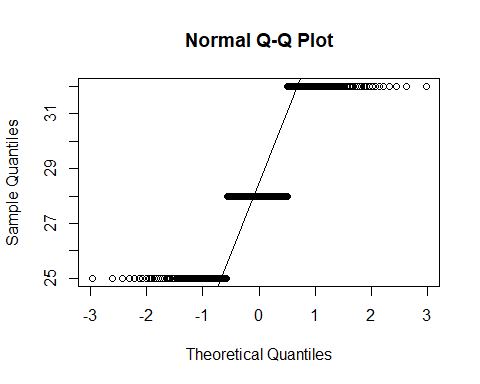
##   
## Pairwise comparisons using Tukey and Kramer (Nemenyi) test   
## with Tukey-Dist approximation for independent samples   
##   
## data: data[, x] by data$Variety   
##   
## Aberchoice Abergain Aspect Carraig Dunluce Lilora Moy   
## Abergain 1.00 - - - - - -   
## Aspect 1.00 0.99 - - - - -   
## Carraig 1.00 1.00 0.90 - - - -   
## Dunluce 1.00 0.99 1.00 0.91 - - -   
## Lilora 1.00 1.00 0.82 1.00 0.83 - -   
## Moy 1.00 1.00 0.97 1.00 0.98 1.00 -   
## Semi-natural11 1.00 1.00 1.00 1.00 1.00 1.00 1.00  
## Semi-natural6 1.00 1.00 0.93 1.00 0.94 1.00 1.00  
## Semi-natural7 1.00 1.00 1.00 1.00 1.00 1.00 1.00  
## Solomon 1.00 1.00 0.65 1.00 0.67 1.00 1.00  
## Wild4 1.00 1.00 0.97 1.00 0.97 1.00 1.00  
## Wild6 1.00 1.00 0.99 1.00 0.99 1.00 1.00  
## Wild7 1.00 1.00 0.99 1.00 0.99 1.00 1.00  
## Semi-natural11 Semi-natural6 Semi-natural7 Solomon Wild4 Wild6  
## Abergain - - - - - -   
## Aspect - - - - - -   
## Carraig - - - - - -   
## Dunluce - - - - - -   
## Lilora - - - - - -   
## Moy - - - - - -   
## Semi-natural11 - - - - - -   
## Semi-natural6 1.00 - - - - -   
## Semi-natural7 1.00 1.00 - - - -   
## Solomon 0.98 1.00 0.98 - - -   
## Wild4 1.00 1.00 1.00 1.00 - -   
## Wild6 1.00 1.00 1.00 1.00 1.00 -   
## Wild7 1.00 1.00 1.00 1.00 1.00 1.00   
##   
## P value adjustment method: none   
## [1] "Leaf Phyllochron 1-4 for July"



##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.84142, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 10784, p-value = 4.225e-05  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 23.314, df = 13, p-value = 0.03806  
##   
## [1] "Leaf Phyllochron 1-4 for August"

##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.80056, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 15793, p-value = 0.04412  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 21.401, df = 13, p-value = 0.06536  
##   
## [1] "As the Kruskal test is significant a posthoc test will be performed"

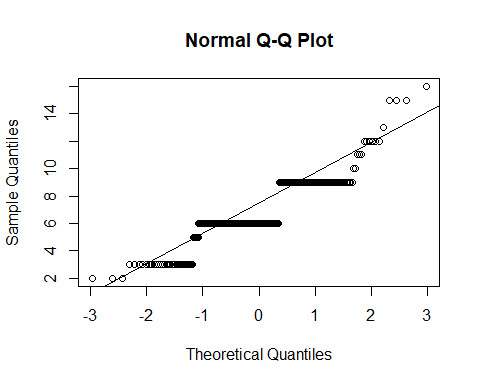
## Warning in posthoc.kruskal.nemenyi.test.default(c(25L, 25L, 32L, 32L, 25L, :  
## Ties are present, p-values are not corrected.



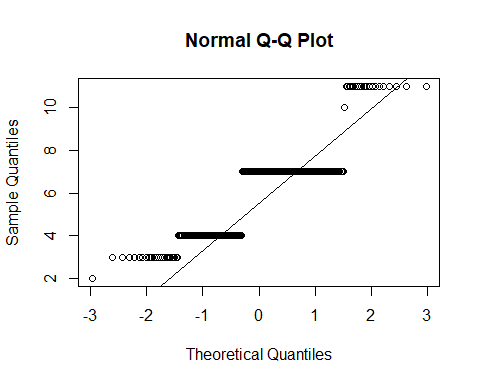
##   
## Pairwise comparisons using Tukey and Kramer (Nemenyi) test   
## with Tukey-Dist approximation for independent samples   
##   
## data: data[, x] by data$Variety   
##   
## Aberchoice Abergain Aspect Carraig Dunluce Lilora Moy   
## Abergain 1.000 - - - - - -   
## Aspect 0.994 1.000 - - - - -   
## Carraig 0.999 0.980 0.556 - - - -   
## Dunluce 0.999 1.000 1.000 0.688 - - -   
## Lilora 1.000 1.000 1.000 0.801 1.000 - -   
## Moy 1.000 1.000 1.000 0.889 1.000 1.000 -   
## Semi-natural11 0.428 0.693 0.994 0.028 0.980 0.950 0.894  
## Semi-natural6 0.995 1.000 1.000 0.561 1.000 1.000 1.000  
## Semi-natural7 0.994 1.000 1.000 0.552 1.000 1.000 1.000  
## Solomon 1.000 1.000 0.980 1.000 0.994 0.999 1.000  
## Wild4 0.948 0.994 1.000 0.305 1.000 1.000 1.000  
## Wild6 1.000 1.000 1.000 0.801 1.000 1.000 1.000  
## Wild7 1.000 1.000 1.000 0.948 1.000 1.000 1.000  
## Semi-natural11 Semi-natural6 Semi-natural7 Solomon Wild4 Wild6  
## Abergain - - - - - -   
## Aspect - - - - - -   
## Carraig - - - - - -   
## Dunluce - - - - - -   
## Lilora - - - - - -   
## Moy - - - - - -   
## Semi-natural11 - - - - - -   
## Semi-natural6 0.994 - - - - -   
## Semi-natural7 0.995 1.000 - - - -   
## Solomon 0.308 0.981 0.980 - - -   
## Wild4 1.000 1.000 1.000 0.889 - -   
## Wild6 0.950 1.000 1.000 0.999 1.000 -   
## Wild7 0.805 1.000 1.000 1.000 0.999 1.000  
##   
## P value adjustment method: none   
## [1] "Leaf Phyllochron 2-3 for May"

##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.85309, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 15146, p-value = 0.2063  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 12.363, df = 13, p-value = 0.4981  
##   
## [1] "As the Kruskal test is significant a posthoc test will be performed"

## Warning in posthoc.kruskal.nemenyi.test.default(c(6L, 6L, 9L, 9L, 15L, 9L, :  
## Ties are present, p-values are not corrected.



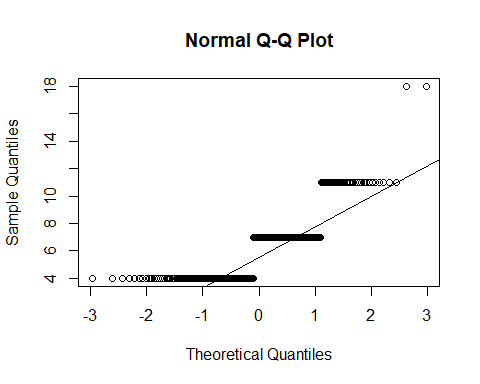
##   
## Pairwise comparisons using Tukey and Kramer (Nemenyi) test   
## with Tukey-Dist approximation for independent samples   
##   
## data: data[, x] by data$Variety   
##   
## Aberchoice Abergain Aspect Carraig Dunluce Lilora Moy   
## Abergain 1.00 - - - - - -   
## Aspect 1.00 1.00 - - - - -   
## Carraig 1.00 1.00 1.00 - - - -   
## Dunluce 1.00 1.00 1.00 1.00 - - -   
## Lilora 1.00 1.00 1.00 1.00 1.00 - -   
## Moy 0.89 0.90 0.99 0.88 1.00 1.00 -   
## Semi-natural11 0.88 0.90 0.99 0.88 1.00 1.00 1.00  
## Semi-natural6 1.00 1.00 1.00 1.00 1.00 1.00 0.97  
## Semi-natural7 1.00 1.00 1.00 1.00 1.00 1.00 1.00  
## Solomon 1.00 1.00 1.00 1.00 1.00 1.00 0.75  
## Wild4 1.00 1.00 1.00 1.00 1.00 1.00 1.00  
## Wild6 1.00 1.00 1.00 1.00 1.00 1.00 0.98  
## Wild7 1.00 1.00 1.00 1.00 1.00 1.00 0.96  
## Semi-natural11 Semi-natural6 Semi-natural7 Solomon Wild4 Wild6  
## Abergain - - - - - -   
## Aspect - - - - - -   
## Carraig - - - - - -   
## Dunluce - - - - - -   
## Lilora - - - - - -   
## Moy - - - - - -   
## Semi-natural11 - - - - - -   
## Semi-natural6 0.97 - - - - -   
## Semi-natural7 1.00 1.00 - - - -   
## Solomon 0.74 1.00 0.99 - - -   
## Wild4 1.00 1.00 1.00 1.00 - -   
## Wild6 0.98 1.00 1.00 1.00 1.00 -   
## Wild7 0.96 1.00 1.00 1.00 1.00 1.00   
##   
## P value adjustment method: none   
## [1] "Leaf Phyllochron 2-3 for June"



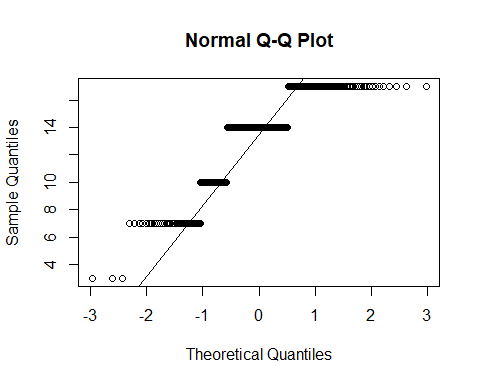
##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.79292, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 11584, p-value = 0.001516  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 55.854, df = 13, p-value = 2.86e-07  
##   
## [1] "Leaf Phyllochron 2-3 for July"

##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.75524, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 13668, p-value = 0.5852  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 9.5556, df = 13, p-value = 0.7298  
##   
## [1] "As the Kruskal test is significant a posthoc test will be performed"

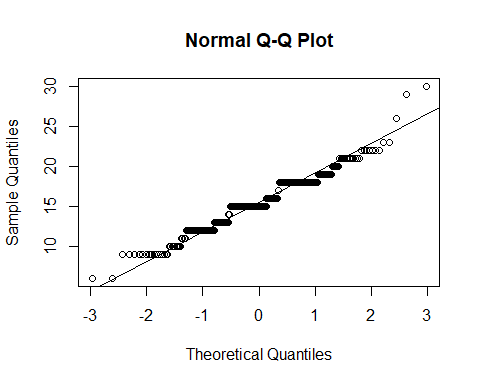
## Warning in posthoc.kruskal.nemenyi.test.default(c(4L, 4L, 7L, 7L, 4L, 4L, : Ties  
## are present, p-values are not corrected.



##   
## Pairwise comparisons using Tukey and Kramer (Nemenyi) test   
## with Tukey-Dist approximation for independent samples   
##   
## data: data[, x] by data$Variety   
##   
## Aberchoice Abergain Aspect Carraig Dunluce Lilora Moy   
## Abergain 1.00 - - - - - -   
## Aspect 0.89 1.00 - - - - -   
## Carraig 1.00 1.00 1.00 - - - -   
## Dunluce 1.00 1.00 1.00 1.00 - - -   
## Lilora 1.00 1.00 1.00 1.00 1.00 - -   
## Moy 1.00 1.00 0.96 1.00 1.00 1.00 -   
## Semi-natural11 1.00 1.00 0.72 0.97 0.99 1.00 1.00  
## Semi-natural6 1.00 1.00 0.92 1.00 1.00 1.00 1.00  
## Semi-natural7 1.00 1.00 0.99 1.00 1.00 1.00 1.00  
## Solomon 1.00 1.00 1.00 1.00 1.00 1.00 1.00  
## Wild4 1.00 1.00 1.00 1.00 1.00 1.00 1.00  
## Wild6 1.00 1.00 1.00 1.00 1.00 1.00 1.00  
## Wild7 0.99 1.00 1.00 1.00 1.00 1.00 1.00  
## Semi-natural11 Semi-natural6 Semi-natural7 Solomon Wild4 Wild6  
## Abergain - - - - - -   
## Aspect - - - - - -   
## Carraig - - - - - -   
## Dunluce - - - - - -   
## Lilora - - - - - -   
## Moy - - - - - -   
## Semi-natural11 - - - - - -   
## Semi-natural6 1.00 - - - - -   
## Semi-natural7 1.00 1.00 - - - -   
## Solomon 1.00 1.00 1.00 - - -   
## Wild4 1.00 1.00 1.00 1.00 - -   
## Wild6 1.00 1.00 1.00 1.00 1.00 -   
## Wild7 0.95 1.00 1.00 1.00 1.00 1.00   
##   
## P value adjustment method: none   
## [1] "Leaf Phyllochron 2-3 for August"



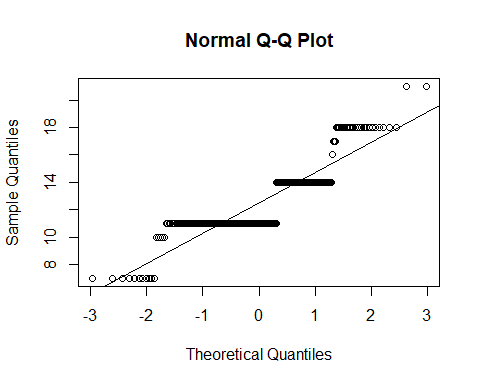
##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.82829, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 15730, p-value = 0.05503  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 23.208, df = 13, p-value = 0.03925  
##   
## [1] "Leaf Phyllochron 2-4 for May"



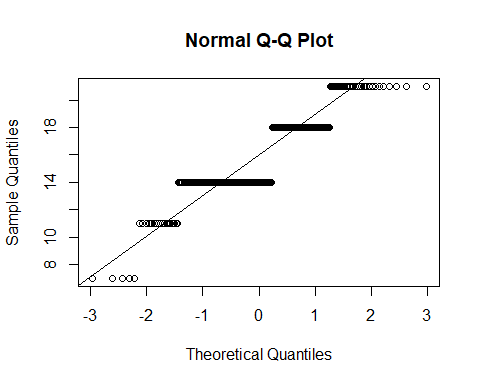
##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.96277, p-value = 1.489e-07  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 13032, p-value = 0.2183  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 34.151, df = 13, p-value = 0.001142  
##   
## [1] "Leaf Phyllochron 2-4 for June"

##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.78528, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 18853, p-value = 1.996e-09  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 12.933, df = 13, p-value = 0.453  
##   
## [1] "As the Kruskal test is significant a posthoc test will be performed"

## Warning in posthoc.kruskal.nemenyi.test.default(c(11L, 14L, 14L, 11L, 14L, :  
## Ties are present, p-values are not corrected.



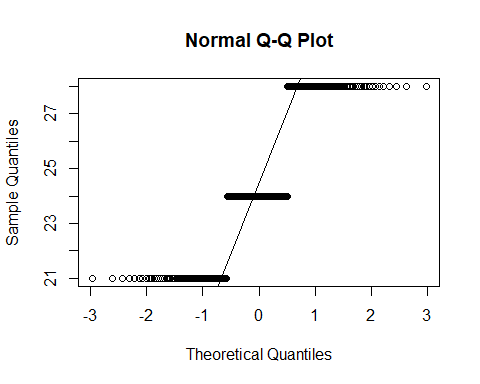
##   
## Pairwise comparisons using Tukey and Kramer (Nemenyi) test   
## with Tukey-Dist approximation for independent samples   
##   
## data: data[, x] by data$Variety   
##   
## Aberchoice Abergain Aspect Carraig Dunluce Lilora Moy   
## Abergain 1.00 - - - - - -   
## Aspect 1.00 0.97 - - - - -   
## Carraig 1.00 1.00 0.89 - - - -   
## Dunluce 1.00 0.98 1.00 0.89 - - -   
## Lilora 1.00 1.00 0.96 1.00 0.96 - -   
## Moy 1.00 1.00 0.89 1.00 0.90 1.00 -   
## Semi-natural11 1.00 1.00 0.94 1.00 0.94 1.00 1.00  
## Semi-natural6 1.00 1.00 0.94 1.00 0.95 1.00 1.00  
## Semi-natural7 1.00 1.00 0.89 1.00 0.90 1.00 1.00  
## Solomon 1.00 1.00 0.78 1.00 0.79 1.00 1.00  
## Wild4 1.00 1.00 0.99 1.00 0.99 1.00 1.00  
## Wild6 1.00 1.00 0.98 1.00 0.99 1.00 1.00  
## Wild7 1.00 1.00 1.00 1.00 1.00 1.00 1.00  
## Semi-natural11 Semi-natural6 Semi-natural7 Solomon Wild4 Wild6  
## Abergain - - - - - -   
## Aspect - - - - - -   
## Carraig - - - - - -   
## Dunluce - - - - - -   
## Lilora - - - - - -   
## Moy - - - - - -   
## Semi-natural11 - - - - - -   
## Semi-natural6 1.00 - - - - -   
## Semi-natural7 1.00 1.00 - - - -   
## Solomon 1.00 1.00 1.00 - - -   
## Wild4 1.00 1.00 1.00 1.00 - -   
## Wild6 1.00 1.00 1.00 1.00 1.00 -   
## Wild7 1.00 1.00 1.00 1.00 1.00 1.00   
##   
## P value adjustment method: none   
## [1] "Leaf Phyllochron 2-4 for July"



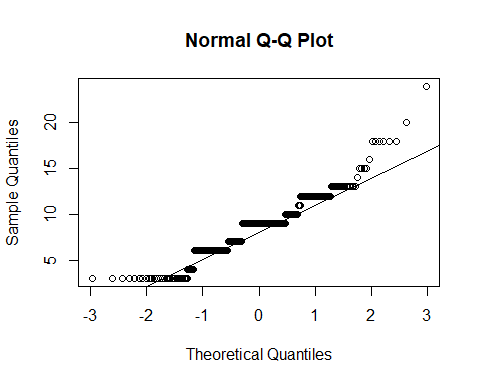
##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.84142, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 10784, p-value = 4.225e-05  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 23.314, df = 13, p-value = 0.03806  
##   
## [1] "Leaf Phyllochron 2-4 for August"

##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.80056, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 15793, p-value = 0.04412  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 21.401, df = 13, p-value = 0.06536  
##   
## [1] "As the Kruskal test is significant a posthoc test will be performed"

## Warning in posthoc.kruskal.nemenyi.test.default(c(21L, 21L, 28L, 28L, 21L, :  
## Ties are present, p-values are not corrected.



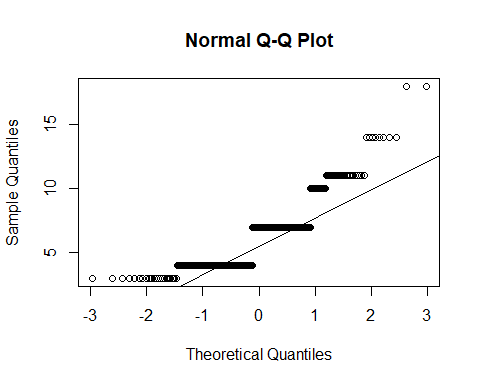
##   
## Pairwise comparisons using Tukey and Kramer (Nemenyi) test   
## with Tukey-Dist approximation for independent samples   
##   
## data: data[, x] by data$Variety   
##   
## Aberchoice Abergain Aspect Carraig Dunluce Lilora Moy   
## Abergain 1.000 - - - - - -   
## Aspect 0.994 1.000 - - - - -   
## Carraig 0.999 0.980 0.556 - - - -   
## Dunluce 0.999 1.000 1.000 0.688 - - -   
## Lilora 1.000 1.000 1.000 0.801 1.000 - -   
## Moy 1.000 1.000 1.000 0.889 1.000 1.000 -   
## Semi-natural11 0.428 0.693 0.994 0.028 0.980 0.950 0.894  
## Semi-natural6 0.995 1.000 1.000 0.561 1.000 1.000 1.000  
## Semi-natural7 0.994 1.000 1.000 0.552 1.000 1.000 1.000  
## Solomon 1.000 1.000 0.980 1.000 0.994 0.999 1.000  
## Wild4 0.948 0.994 1.000 0.305 1.000 1.000 1.000  
## Wild6 1.000 1.000 1.000 0.801 1.000 1.000 1.000  
## Wild7 1.000 1.000 1.000 0.948 1.000 1.000 1.000  
## Semi-natural11 Semi-natural6 Semi-natural7 Solomon Wild4 Wild6  
## Abergain - - - - - -   
## Aspect - - - - - -   
## Carraig - - - - - -   
## Dunluce - - - - - -   
## Lilora - - - - - -   
## Moy - - - - - -   
## Semi-natural11 - - - - - -   
## Semi-natural6 0.994 - - - - -   
## Semi-natural7 0.995 1.000 - - - -   
## Solomon 0.308 0.981 0.980 - - -   
## Wild4 1.000 1.000 1.000 0.889 - -   
## Wild6 0.950 1.000 1.000 0.999 1.000 -   
## Wild7 0.805 1.000 1.000 1.000 0.999 1.000  
##   
## P value adjustment method: none   
## [1] "Leaf Phyllochron 3-4 for May"



##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.93788, p-value = 1.199e-10  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 12696, p-value = 0.1053  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 27.651, df = 13, p-value = 0.01012  
##   
## [1] "Leaf Phyllochron 3-4 for June"

##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.83364, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 19129, p-value = 2.561e-09  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 19.102, df = 13, p-value = 0.12  
##   
## [1] "As the Kruskal test is significant a posthoc test will be performed"

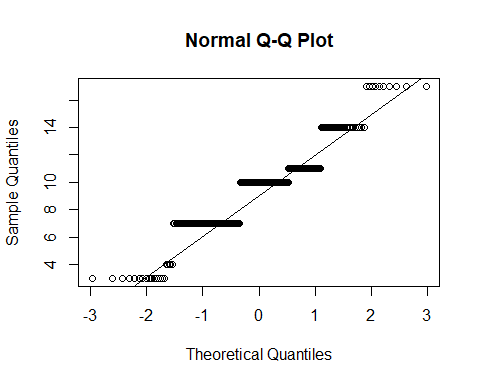
## Warning in posthoc.kruskal.nemenyi.test.default(c(4L, 10L, 7L, 7L, 3L, 7L, :  
## Ties are present, p-values are not corrected.



##   
## Pairwise comparisons using Tukey and Kramer (Nemenyi) test   
## with Tukey-Dist approximation for independent samples   
##   
## data: data[, x] by data$Variety   
##   
## Aberchoice Abergain Aspect Carraig Dunluce Lilora Moy   
## Abergain 1.00 - - - - - -   
## Aspect 1.00 1.00 - - - - -   
## Carraig 1.00 1.00 0.99 - - - -   
## Dunluce 1.00 1.00 1.00 1.00 - - -   
## Lilora 1.00 0.99 1.00 0.79 0.94 - -   
## Moy 1.00 0.99 1.00 0.84 0.96 1.00 -   
## Semi-natural11 0.99 0.95 1.00 0.62 0.85 1.00 1.00  
## Semi-natural6 1.00 1.00 1.00 1.00 1.00 0.98 0.99  
## Semi-natural7 1.00 0.99 1.00 0.81 0.95 1.00 1.00  
## Solomon 1.00 1.00 1.00 1.00 1.00 0.92 0.95  
## Wild4 0.98 0.94 1.00 0.59 0.83 1.00 1.00  
## Wild6 1.00 0.98 1.00 0.76 0.93 1.00 1.00  
## Wild7 1.00 1.00 1.00 0.86 0.97 1.00 1.00  
## Semi-natural11 Semi-natural6 Semi-natural7 Solomon Wild4 Wild6  
## Abergain - - - - - -   
## Aspect - - - - - -   
## Carraig - - - - - -   
## Dunluce - - - - - -   
## Lilora - - - - - -   
## Moy - - - - - -   
## Semi-natural11 - - - - - -   
## Semi-natural6 0.93 - - - - -   
## Semi-natural7 1.00 0.98 - - - -   
## Solomon 0.81 1.00 0.93 - - -   
## Wild4 1.00 0.92 1.00 0.79 - -   
## Wild6 1.00 0.97 1.00 0.91 1.00 -   
## Wild7 1.00 0.99 1.00 0.96 1.00 1.00   
##   
## P value adjustment method: none   
## [1] "Leaf Phyllochron 3-4 for July"

##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.9092, p-value = 2.432e-13  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 12070, p-value = 0.01737  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 10.359, df = 13, p-value = 0.6644  
##   
## [1] "As the Kruskal test is significant a posthoc test will be performed"

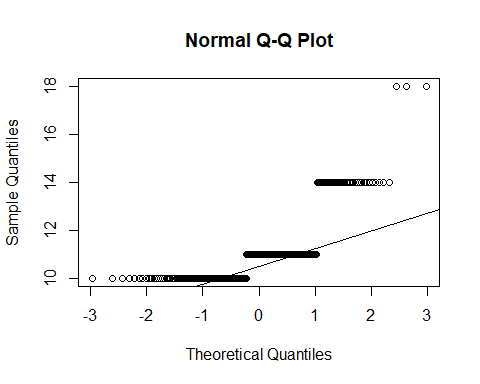
## Warning in posthoc.kruskal.nemenyi.test.default(c(14L, 14L, 7L, 11L, 14L, : Ties  
## are present, p-values are not corrected.



##   
## Pairwise comparisons using Tukey and Kramer (Nemenyi) test   
## with Tukey-Dist approximation for independent samples   
##   
## data: data[, x] by data$Variety   
##   
## Aberchoice Abergain Aspect Carraig Dunluce Lilora Moy   
## Abergain 1.00 - - - - - -   
## Aspect 1.00 1.00 - - - - -   
## Carraig 1.00 1.00 1.00 - - - -   
## Dunluce 1.00 1.00 1.00 1.00 - - -   
## Lilora 1.00 1.00 1.00 1.00 1.00 - -   
## Moy 1.00 1.00 1.00 1.00 0.99 1.00 -   
## Semi-natural11 1.00 1.00 1.00 1.00 0.93 1.00 1.00  
## Semi-natural6 0.98 0.98 1.00 0.98 0.70 0.93 1.00  
## Semi-natural7 1.00 1.00 1.00 1.00 1.00 1.00 1.00  
## Solomon 1.00 1.00 1.00 1.00 1.00 1.00 1.00  
## Wild4 0.98 0.99 1.00 0.99 0.74 0.95 1.00  
## Wild6 1.00 1.00 1.00 1.00 0.98 1.00 1.00  
## Wild7 1.00 1.00 1.00 1.00 1.00 1.00 1.00  
## Semi-natural11 Semi-natural6 Semi-natural7 Solomon Wild4 Wild6  
## Abergain - - - - - -   
## Aspect - - - - - -   
## Carraig - - - - - -   
## Dunluce - - - - - -   
## Lilora - - - - - -   
## Moy - - - - - -   
## Semi-natural11 - - - - - -   
## Semi-natural6 1.00 - - - - -   
## Semi-natural7 1.00 1.00 - - - -   
## Solomon 1.00 0.95 1.00 - - -   
## Wild4 1.00 1.00 1.00 0.97 - -   
## Wild6 1.00 1.00 1.00 1.00 1.00 -   
## Wild7 1.00 1.00 1.00 1.00 1.00 1.00   
##   
## P value adjustment method: none   
## [1] "Leaf Phyllochron 3-4 for August"

##   
## Shapiro-Wilk normality test  
##   
## data: data[, x]  
## W = 0.6667, p-value < 2.2e-16  
##   
## [1] "Based on shapiro test normality cannot be assumed"  
##   
## Wilcoxon rank sum test with continuity correction  
##   
## data: data[, x] by data$Treatment  
## W = 15644, p-value = 0.06124  
## alternative hypothesis: true location shift is not equal to 0  
##   
##   
## Kruskal-Wallis rank sum test  
##   
## data: data[, x] by data$Variety  
## Kruskal-Wallis chi-squared = 3.8994, df = 13, p-value = 0.9922  
##   
## [1] "As the Kruskal test is significant a posthoc test will be performed"

## Warning in posthoc.kruskal.nemenyi.test.default(c(14L, 14L, 11L, 11L, 11L, :  
## Ties are present, p-values are not corrected.



##   
## Pairwise comparisons using Tukey and Kramer (Nemenyi) test   
## with Tukey-Dist approximation for independent samples   
##   
## data: data[, x] by data$Variety   
##   
## Aberchoice Abergain Aspect Carraig Dunluce Lilora Moy  
## Abergain 1 - - - - - -   
## Aspect 1 1 - - - - -   
## Carraig 1 1 1 - - - -   
## Dunluce 1 1 1 1 - - -   
## Lilora 1 1 1 1 1 - -   
## Moy 1 1 1 1 1 1 -   
## Semi-natural11 1 1 1 1 1 1 1   
## Semi-natural6 1 1 1 1 1 1 1   
## Semi-natural7 1 1 1 1 1 1 1   
## Solomon 1 1 1 1 1 1 1   
## Wild4 1 1 1 1 1 1 1   
## Wild6 1 1 1 1 1 1 1   
## Wild7 1 1 1 1 1 1 1   
## Semi-natural11 Semi-natural6 Semi-natural7 Solomon Wild4 Wild6  
## Abergain - - - - - -   
## Aspect - - - - - -   
## Carraig - - - - - -   
## Dunluce - - - - - -   
## Lilora - - - - - -   
## Moy - - - - - -   
## Semi-natural11 - - - - - -   
## Semi-natural6 1 - - - - -   
## Semi-natural7 1 1 - - - -   
## Solomon 1 1 1 - - -   
## Wild4 1 1 1 1 - -   
## Wild6 1 1 1 1 1 -   
## Wild7 1 1 1 1 1 1   
##   
## P value adjustment method: none