Carryover 2.0

Kolby Grint

11/20/2020

```
getwd()
```

```
## [1] "C:/Users/grink/Desktop/Box Sync/Grad School/Grad School Stuff/Manuscripts/Carryover Manuscript"
```

```
Corn1= read.csv(file="Corn_MasterData.csv")
Soybean1= read.csv(file="Soybean_MasterData.csv")
ArlingtonCN20= read.csv(file="ArlingtonCorn2020.csv")


str(Corn1)
```

```
## 'data.frame':    360 obs. of  13 variables:
##  $ Location    : Factor w/ 3 levels "Arlington","Havelock",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ Crop        : Factor w/ 1 level "Corn": 1 1 1 1 1 1 1 1 1 1 ...
##  $ Year        : int  2019 2019 2019 2019 2019 2019 2019 2019 2019 2019 ...
##  $ Site_crop_yr: Factor w/ 6 levels "ARL_CN_19","ARL_CN_20",..: 1 1 1 1 1 1 1 1 1 1 ...
##  $ CRD         : Factor w/ 2 levels "N","Y": 1 1 1 1 1 1 1 1 1 1 ...
##  $ Rep         : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ EU          : int  101 102 103 104 105 106 107 108 109 110 ...
##  $ Soil        : Factor w/ 3 levels "CC","NT","Till": 3 2 1 2 1 3 3 2 1 3 ...
##  $ Herb        : Factor w/ 5 levels "CTRL","FO25",..: 1 2 3 3 5 2 5 1 2 3 ...
##  $ CYInjury    : int  0 0 1 0 0 0 0 0 0 1 ...
##  $ Crop.Canopy : num  5.03 3.33 3.75 3.57 3.93 ...
##  $ yield       : num  14135 14221 13709 13464 12374 ...
##  $ Stand.Count : num  78740 74366 83114 74366 74366 ...
```

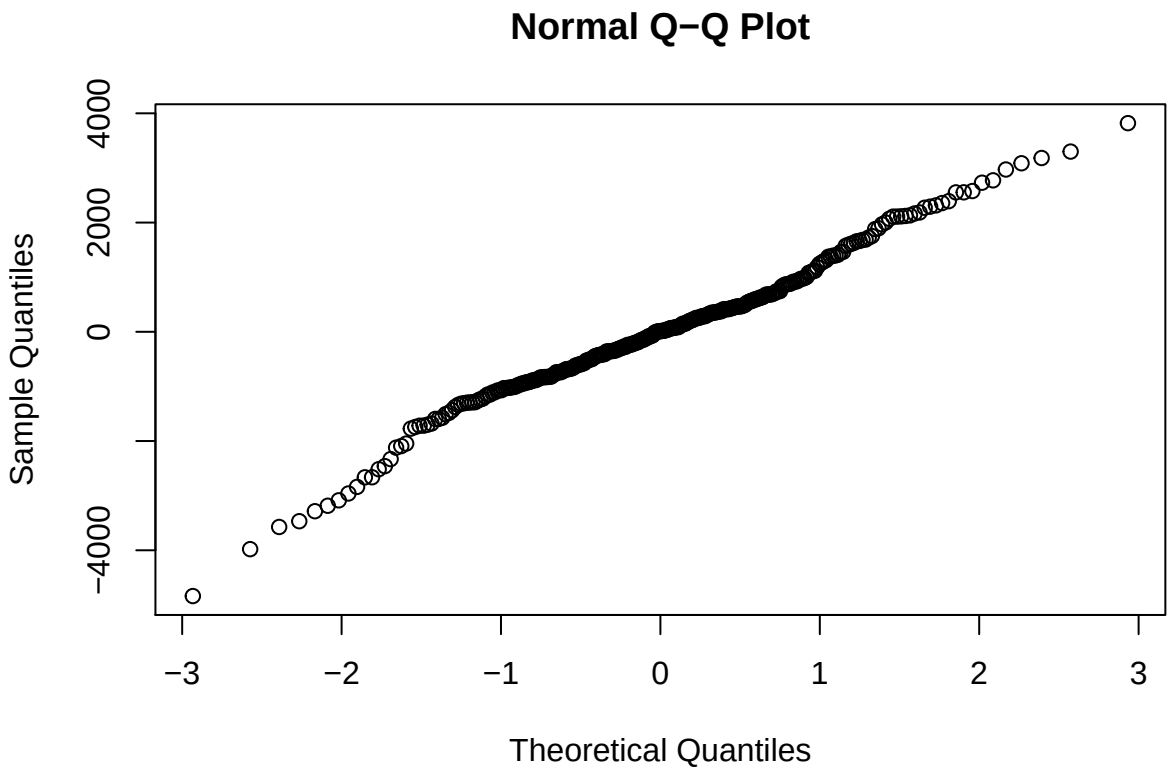
```
str(Soybean1)
```

```
## 'data.frame':    360 obs. of  12 variables:
##  $ Location    : Factor w/ 3 levels "Arlington","Havelock",..: 2 2 2 2 2 2 2 2 2 2 ...
##  $ Crop        : Factor w/ 1 level "Soybean": 1 1 1 1 1 1 1 1 1 1 ...
##  $ Year        : int  2019 2019 2019 2019 2019 2019 2019 2019 2019 2019 ...
##  $ Site_crop_yr: Factor w/ 6 levels "ARL_SB_19","ARL_SB_20",..: 3 3 3 3 3 3 3 3 3 3 ...
##  $ Rep         : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ EU          : int  101 102 103 104 105 106 107 108 109 110 ...
##  $ Soil        : Factor w/ 3 levels "NT","NT+CC","Till": 3 2 1 3 1 2 3 2 1 1 ...
##  $ Herb        : Factor w/ 5 levels "CL25","CL50",..: 4 5 5 1 3 2 3 3 4 1 ...
##  $ CYInjury    : int  0 0 0 1 0 0 0 0 1 0 ...
##  $ Crop.Canopy : num  11.05 6.36 4.19 9.12 6.04 ...
##  $ yield       : num  2856 2892 2522 2715 3291 ...
##  $ Stand.Count : num  231846 227471 135608 301837 262467 ...
```

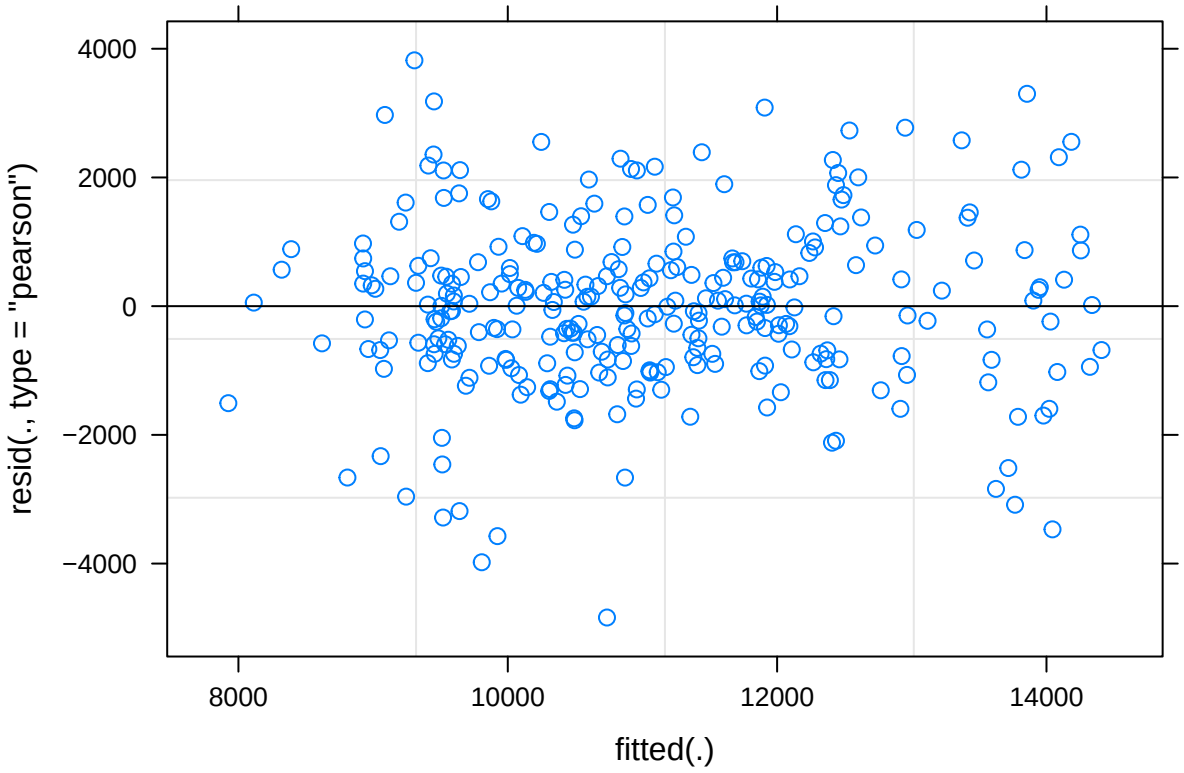
Corn Yield

Yield for Majority of Corn studies

```
CNMaj= filter (Corn1, CRD == "N")

CN.Mod1= lmer(yield~ Site_crop_yr*Soil*Herb + (1|Site_crop_yr:Rep), data=CNMaj)

qqnorm(resid(CN.Mod1))
```




```
plot(CN.Mod1)
```




```
#Assumptions for normality and equal variance met beautifully

anova(CN.Mod1)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##                            Sum Sq  Mean Sq NumDF   DenDF F value    Pr(>F)
## Site_crop_yr             30327846  7581961     4  15.089  3.2083    0.0430 *
## Soil                    175258362 87629181     2 208.244 37.0803 1.678e-14 ***
## Herb                      1458904   364726     4 208.316  0.1543    0.9609
## Site_crop_yr:Soil       178656541 22332068     8 208.243  9.4498 4.029e-11 ***
## Site_crop_yr:Herb        16241357  1015085    16 208.311  0.4295    0.9735
## Soil:Herb                 8918499  1114812     8 209.028  0.4717    0.8752
## Site_crop_yr:Soil:Herb   43872685  1371021    32 208.940  0.5801    0.9660
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# Site-year:Soil 2-way interaction significant

cornmeans= lsmeans(CN.Mod1 ,~ Soil|Site_crop_yr, contr="pairwise", adjust="none", type="response")
```

```
## NOTE: Results may be misleading due to involvement in interactions
```

```
cornmeans1CLD<- CLD(cornmeans, alpha=0.05, Letters=letters, adjust="none", sort=TRUE, reverse=TRUE)
```

```
## Warning: 'CLD' will be deprecated. Its use is discouraged.
## See '? CLD' for an explanation. Use 'pwpp' or 'multcomp::cld' instead.
```

```
## Warning in CLD.emm_list(cornmeans, alpha = 0.05, Letters = letters, adjust =
## "none", : `CLD()` called with a list of 2 objects. Only the first one was used.
```

```
## Warning: 'CLD' will be deprecated. Its use is discouraged.
## See '? CLD' for an explanation. Use 'pwpp' or 'multcomp::cld' instead.
```

```
cornmeans1CLD
```

```
## Site_crop_yr = ARL_CN_19:
##  Soil lsmean  SE   df lower.CL upper.CL .group
##  Till  12252 481 33.4    11274    13229  a
##  NT    12099 481 33.4    11121    13076  ab
##  CC    11204 481 33.4    10227    12182   b
##
## Site_crop_yr = HAV_CN_19:
##  Soil lsmean  SE   df lower.CL upper.CL .group
##  Till  11851 484 34.3    10868    12834  a
##  CC    11297 492 36.5    10299    12295  ab
##  NT    10493 484 34.3     9510    11476   b
##
## Site_crop_yr = HAV_CN_20:
##  Soil lsmean  SE   df lower.CL upper.CL .group
##  Till  10532 484 34.3     9549    11515  a
##  NT    10003 481 33.4     9025    10980  ab
##  CC     9484 484 34.3     8500    10467   b
##
## Site_crop_yr = LAN_CN_19:
##  Soil lsmean  SE   df lower.CL upper.CL .group
##  Till  13979 481 33.4    13002    14957  a
##  CC     9423 489 35.6     8431    10416   b
##  NT     9070 481 33.4     8093    10047   b
##
## Site_crop_yr = LAN_CN_20:
##  Soil lsmean  SE   df lower.CL upper.CL .group
##  Till  12164 481 33.4    11186    13141  a
##  CC    11168 481 33.4    10191    12146   b
##  NT    10983 481 33.4    10005    11960   b
##
## Results are averaged over the levels of: Herb
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
## significance level used: alpha = 0.05
```

Tillage Had the highest corn yield at all locations.

Majority of Corn Canopy Cover

```r
CNMaj= CNMaj %>%
  mutate(CNcanopy= Crop.Canopy/100)

CN.Mod2= glmmTMB(CNcanopy~ Site_crop_yr*Soil*Herb + (1|Site_crop_yr:Rep), data=CNMaj, beta_family(link=

Anova(CN.Mod2)
```

```
## Analysis of Deviance Table (Type II Wald chisquare tests)
##
## Response: CNcanopy
##                            Chisq Df Pr(>Chisq)
## Site_crop_yr           1543.2035  4  < 2.2e-16 ***
## Soil                     16.7228  2  0.0002337 ***
## Herb                     12.3376  4  0.0150097 *
## Site_crop_yr:Soil        33.2584  8  5.532e-05 ***
## Site_crop_yr:Herb        18.9533 16  0.2710912
## Soil:Herb                 7.4963  8  0.4841468
## Site_crop_yr:Soil:Herb   22.3448 32  0.8979091
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
#Site_crop_yr:Soil 2-way interaction and herbicide fixed effect significant

corncanopy= emmeans(CN.Mod2 ,~ Soil|Site_crop_yr, contr="pairwise", adjust="none", type="response")
```

```
## NOTE: Results may be misleading due to involvement in interactions
```

```r
corncanopyCLD<- CLD(corncanopy, alpha=0.05, Letters=letters, adjust="none", sort=TRUE, reverse=TRUE)
```

```
## Warning: 'CLD' will be deprecated. Its use is discouraged.
## See '? CLD' for an explanation. Use 'pwpp' or 'multcomp::cld' instead.

## Warning in CLD.emm_list(corncanopy, alpha = 0.05, Letters = letters, adjust =
## "none", : `CLD()` called with a list of 2 objects. Only the first one was used.

## Warning: 'CLD' will be deprecated. Its use is discouraged.
## See '? CLD' for an explanation. Use 'pwpp' or 'multcomp::cld' instead.
```

```r
corncanopyCLD
```

```
## Site_crop_yr = ARL_CN_19:
##  Soil response      SE  df lower.CL upper.CL .group
##  Till   0.0512 0.00339 220   0.0449   0.0583  a
##  NT     0.0434 0.00307 220   0.0377   0.0498  ab
##  CC     0.0426 0.00304 220   0.0370   0.0490   b
##
## Site_crop_yr = HAV_CN_19:
##  Soil response      SE  df lower.CL upper.CL .group
##  Till   0.1090 0.00538 220   0.0988   0.1200  a
##  CC     0.1064 0.00541 220   0.0961   0.1175  a
```

```
##  NT     0.0887 0.00477 220   0.0797   0.0985   b
##
## Site_crop_yr = HAV_CN_20:
##  Soil response      SE  df lower.CL upper.CL .group
##  Till   0.1643 0.00688 220   0.1512   0.1783  a
##  CC     0.1618 0.00682 220   0.1489   0.1757  a
##  NT     0.1550 0.00659 220   0.1424   0.1684  a
##
## Site_crop_yr = LAN_CN_19:
##  Soil response      SE  df lower.CL upper.CL .group
##  Till   0.0767 0.00442 220   0.0684   0.0859  a
##  NT     0.0695 0.00407 220   0.0619   0.0779  ab
##  CC     0.0616 0.00389 220   0.0544   0.0698   b
##
## Site_crop_yr = LAN_CN_20:
##  Soil response      SE  df lower.CL upper.CL .group
##  NT     0.3050 0.00946 220   0.2867   0.3240  a
##  Till   0.2974 0.00936 220   0.2793   0.3161  a
##  CC     0.2671 0.00890 220   0.2499   0.2850   b
##
## Results are averaged over the levels of: Herb
## Confidence level used: 0.95
## Intervals are back-transformed from the logit scale
## Tests are performed on the log odds ratio scale
## significance level used: alpha = 0.05
```

```
corncanopyHerb= emmeans(CN.Mod2 ,~ Herb, contr="pairwise", adjust="none", type="response")
```

```
## NOTE: Results may be misleading due to involvement in interactions
```

```
corncanopyHerbCLD<- CLD(corncanopyHerb, alpha=0.05, Letters=letters, adjust="none", sort=TRUE, reverse='
```

```
## Warning: 'CLD' will be deprecated. Its use is discouraged.
## See '? CLD' for an explanation. Use 'pwpp' or 'multcomp::cld' instead.
```

```
## Warning in CLD.emm_list(corncanopyHerb, alpha = 0.05, Letters = letters, :
## `CLD()` called with a list of 2 objects. Only the first one was used.
```

```
## Warning: 'CLD' will be deprecated. Its use is discouraged.
## See '? CLD' for an explanation. Use 'pwpp' or 'multcomp::cld' instead.
```

```
corncanopyHerbCLD
```

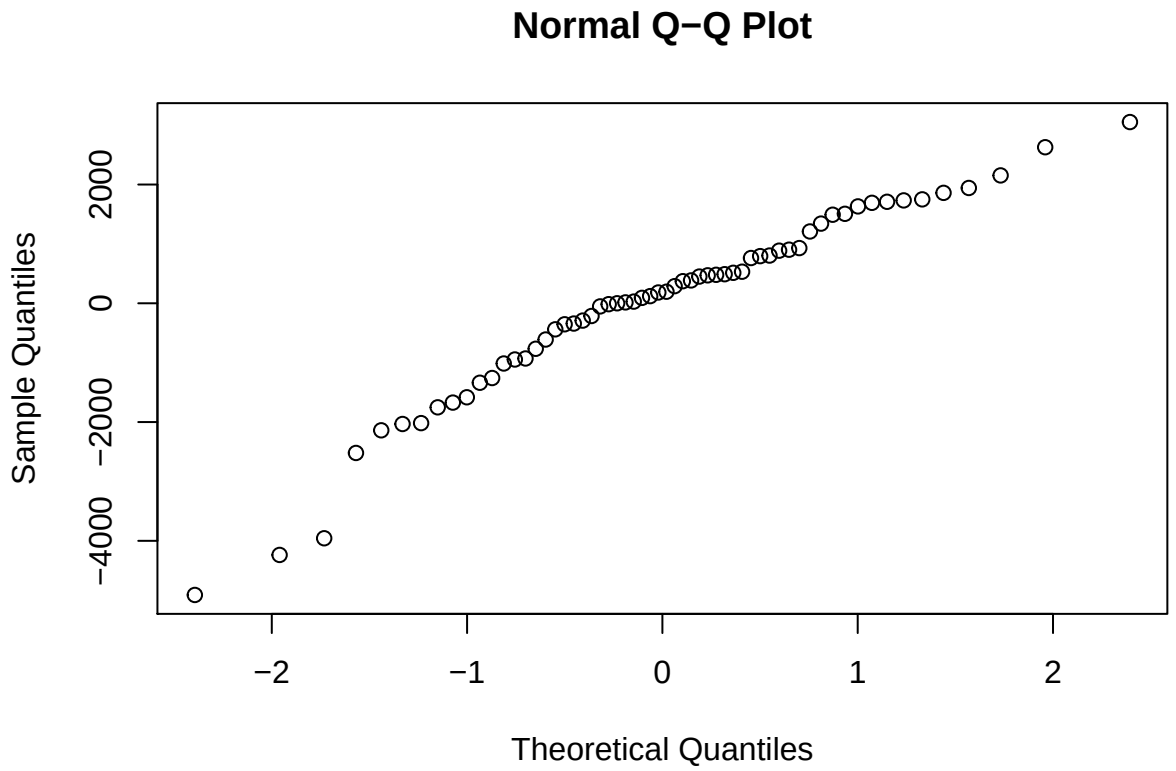
```
##  Herb response      SE  df lower.CL upper.CL .group
##  FO50    0.114 0.00322 220    0.108    0.121  a
##  CTRL    0.114 0.00321 220    0.107    0.120  a
##  IM25    0.112 0.00312 220    0.106    0.119  ab
##  FO25    0.111 0.00315 220    0.105    0.117  ab
##  IM50    0.106 0.00299 220    0.100    0.112   b
##
## Results are averaged over the levels of: Site_crop_yr, Soil
```

```
## Confidence level used: 0.95
## Intervals are back-transformed from the logit scale
## Tests are performed on the log odds ratio scale
## significance level used: alpha = 0.05
```

Canopy coverage response varied. The high rate of imazethapyr reduced canopy coverage.

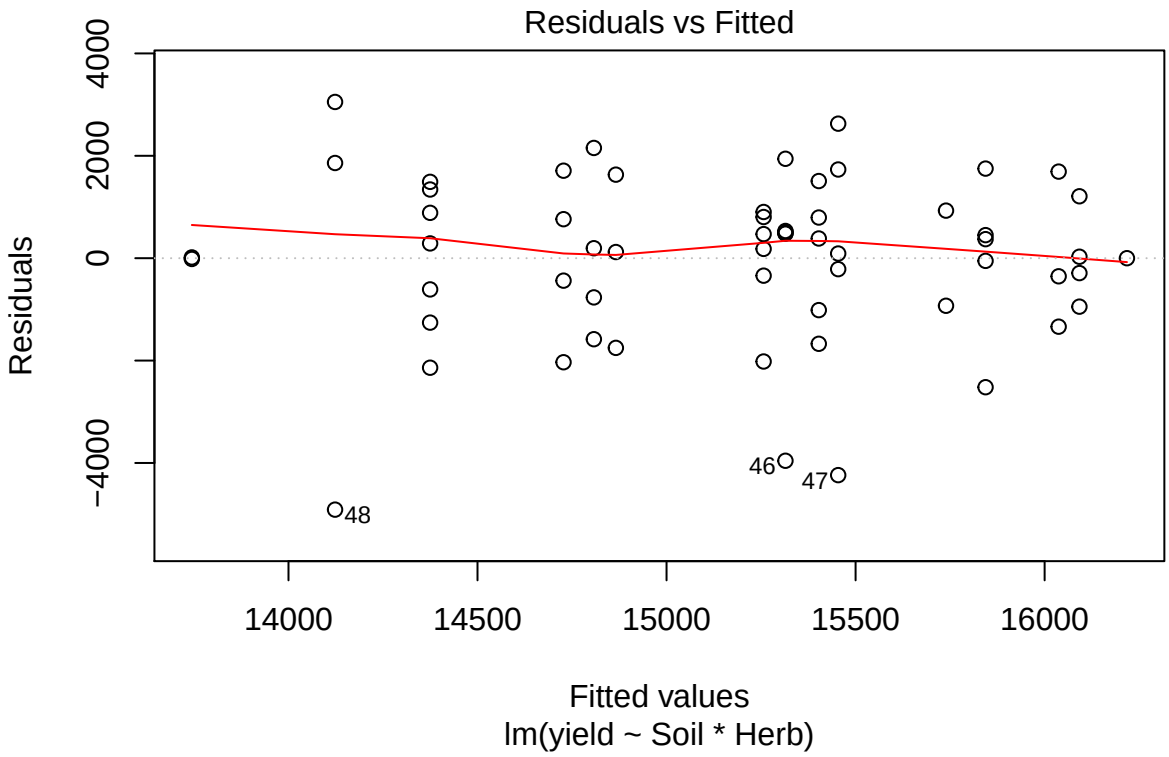
Arlington Corn 2020 CRD Corn Yield

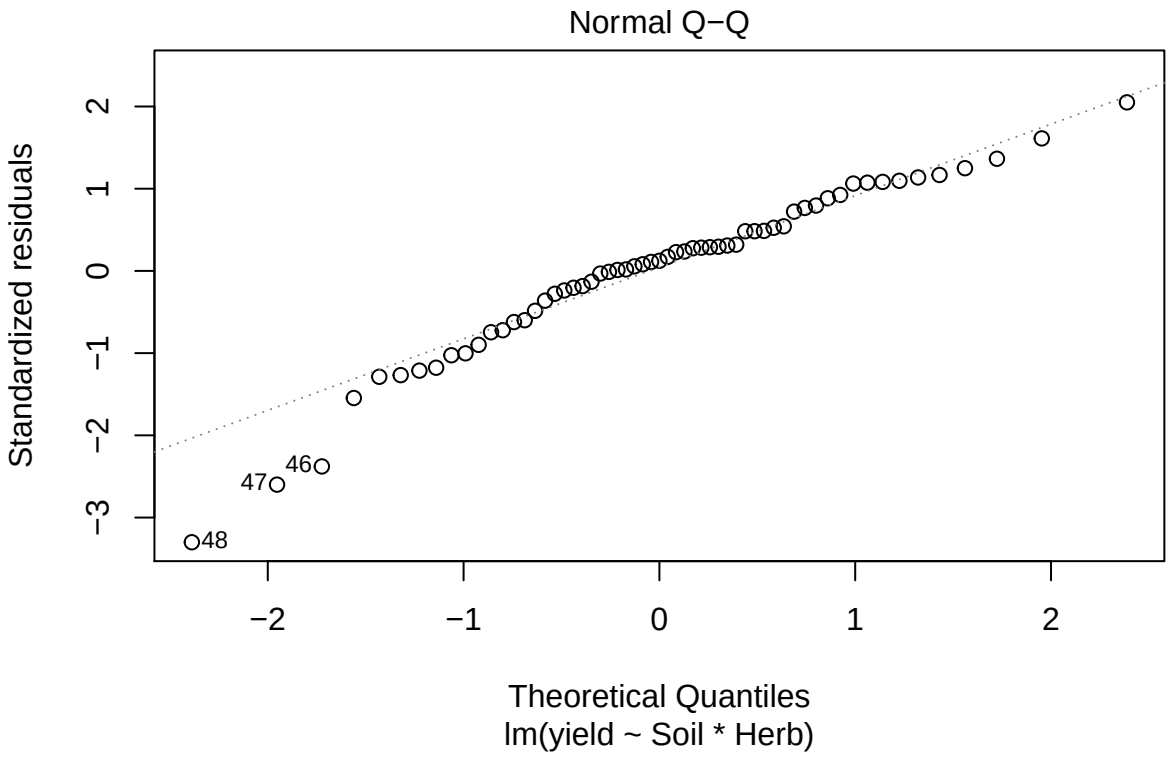
```
ARL20= filter(Corn1, CRD == "Y")

CN.Mod3= lm(yield~ Soil*Herb, data=ARL20)

qqnorm(resid(CN.Mod3))
```



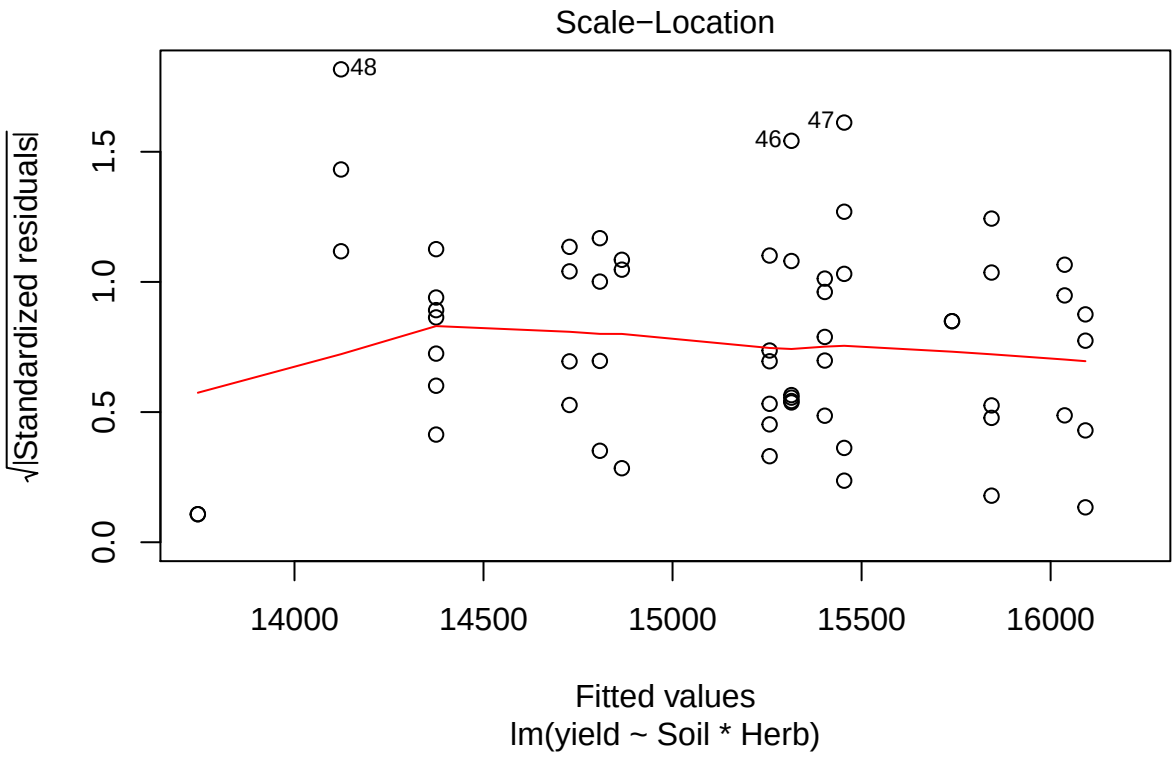

```
plot(CN.Mod3)
```

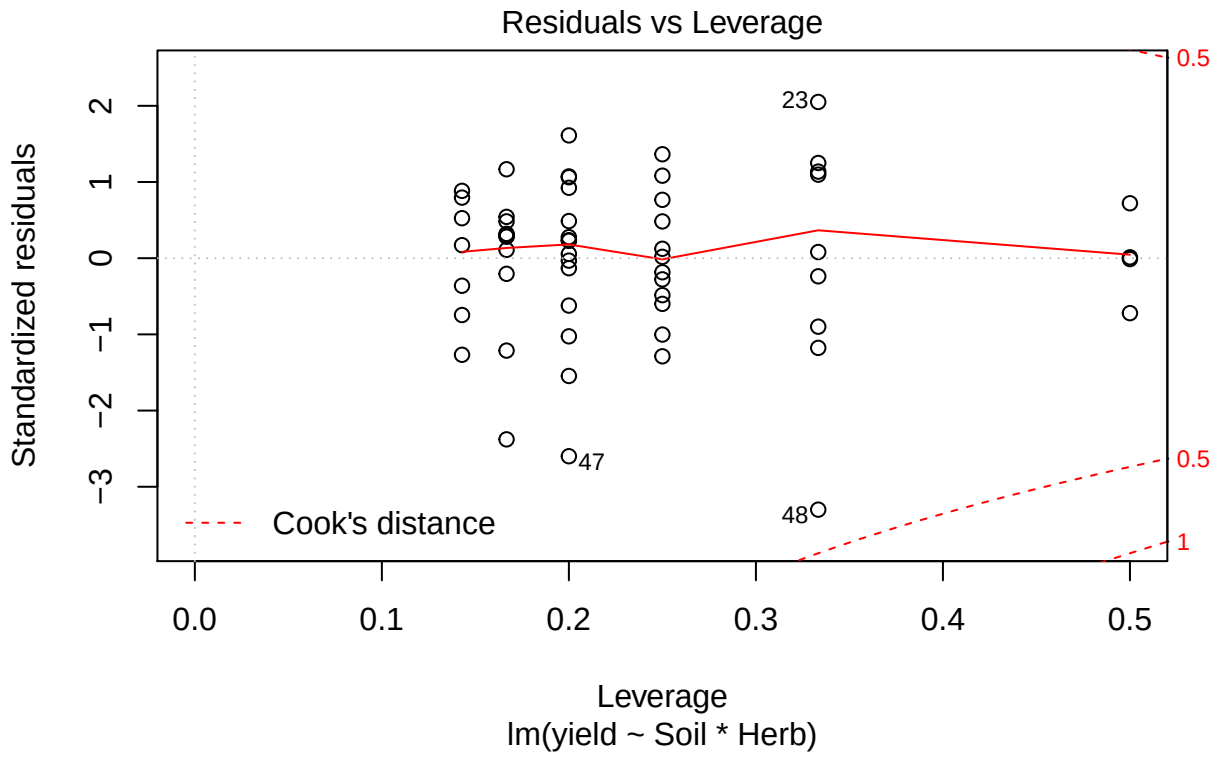
```
## Warning: not plotting observations with leverage one:
##   6
```


Residuals vs Fitted
Residuals
4000
2000
0
−4000
48
46
47
14000
14500
15000
15500
16000
Fitted values
lm(yield ~ Soil * Herb)




```
## Warning: not plotting observations with leverage one:
##   6
```


Scale−Location
√|Standardized residuals|
0.0
0.5
1.0
1.5
48
47
46
14000
14500
15000
15500
16000
Fitted values
lm(yield ~ Soil * Herb)




```
anova(CN.Mod3)
```

```
## Analysis of Variance Table
##
## Response: yield
##           Df    Sum Sq Mean Sq F value Pr(>F)
## Soil       2   2555458 1277729  0.3846 0.6830
## Herb       4   5714060 1428515  0.4300 0.7862
## Soil:Herb  8  15612917 1951615  0.5874 0.7829
## Residuals 45 149510905 3322465
```

```
#Nothing is significant
```

No significant effects on yield at this location

Arlington Corn 2020 CRD Canopy Coverage

```
ARL20= ARL20 %>%
  mutate(CNcanopy= Crop.Canopy/100)

CN.Mod4= glmmTMB(CNcanopy~ Soil*Herb, data=ARL20, beta_family(link="logit"))

Anova(CN.Mod4)
```

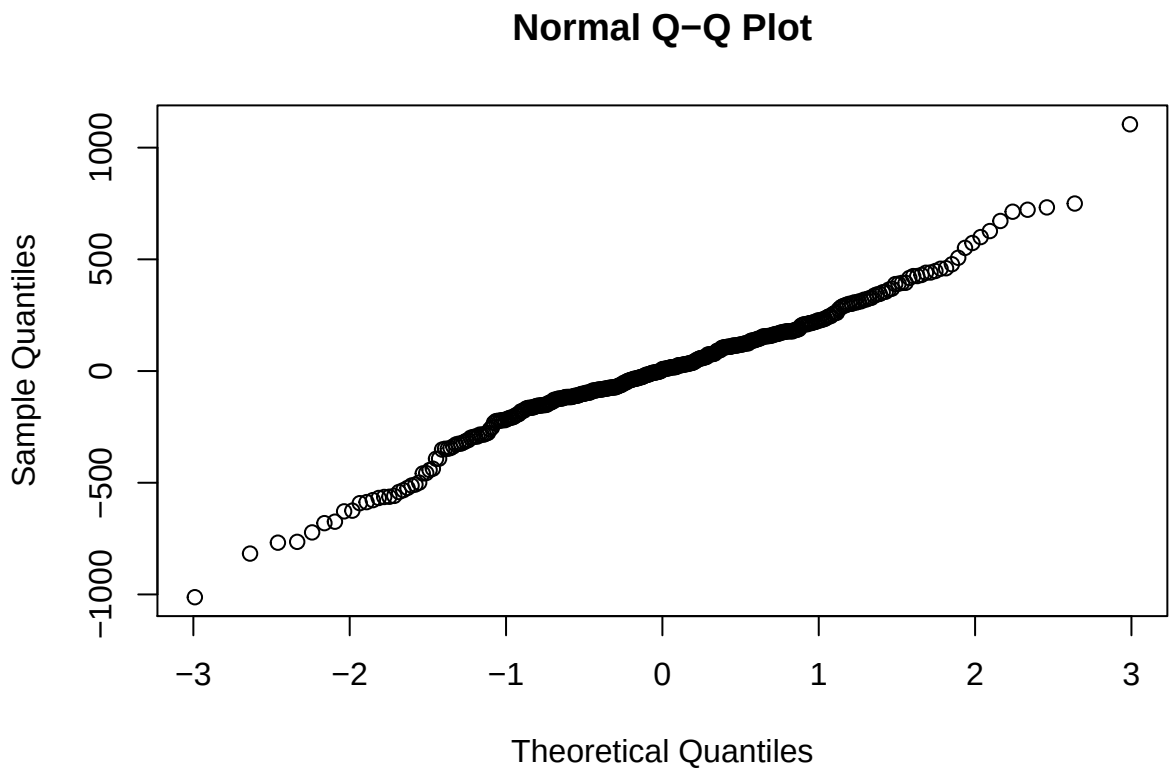
```
## Analysis of Deviance Table (Type II Wald chisquare tests)
##
## Response: CNcanopy
##             Chisq Df Pr(>Chisq)
## Soil       3.6048  2     0.1649
## Herb       6.2407  4     0.1819
## Soil:Herb 10.9796  8     0.2029
```

```
#Nothing significant
```

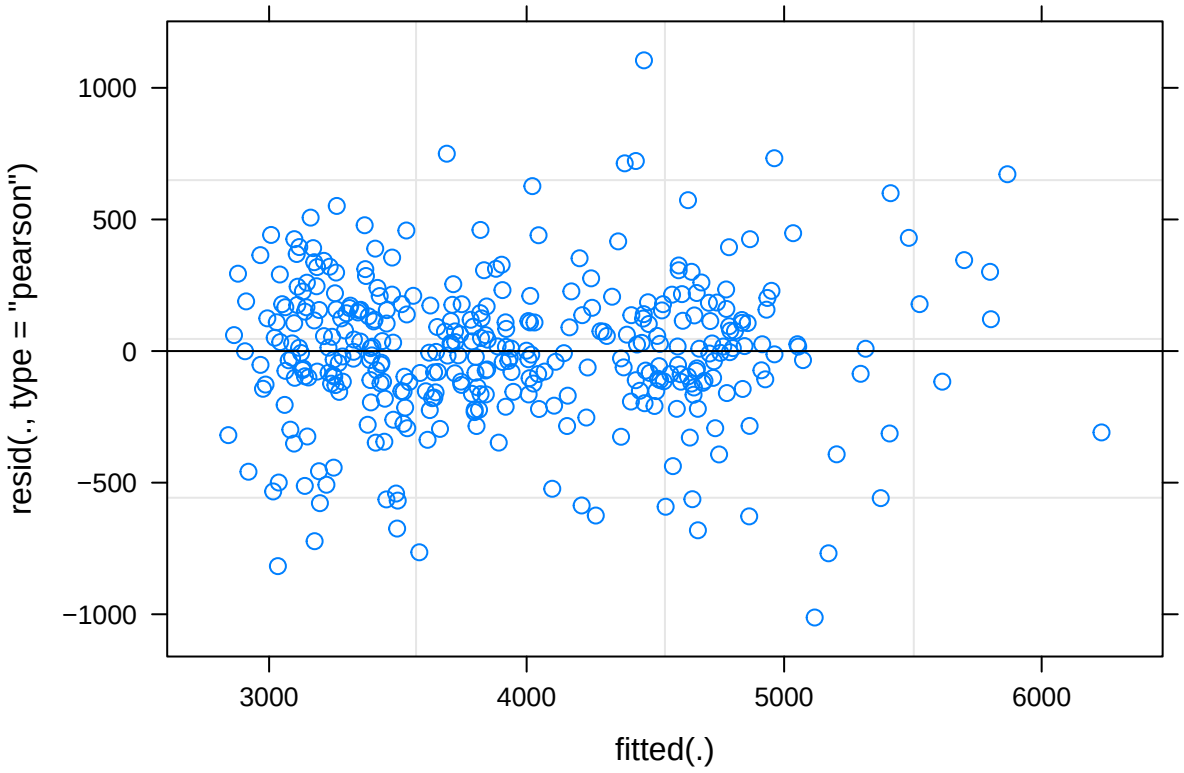
No significant effects on Canopy coverage at this location

#Soybean Yield

```
SB.Mod1= lmer(yield~ Site_crop_yr*Soil*Herb + (1|Site_crop_yr:Rep), data=Soybean1)

qqnorm(resid(SB.Mod1))
```




```
plot(SB.Mod1)
```




```
#Assumptions for normality and equal variance are met

anova(SB.Mod1)
```

```
## Type III Analysis of Variance Table with Satterthwaite's method
##                           Sum Sq Mean Sq NumDF   DenDF F value    Pr(>F)
## Site_crop_yr           11413493 2282699     5  17.969 21.5199 5.191e-07 ***
## Soil                     401412  200706     2 250.980  1.8921 0.1528934
## Herb                     285253   71313     4 250.980  0.6723 0.6117508
## Site_crop_yr:Soil       3347583  334758    10 250.980  3.1559 0.0007962 ***
## Site_crop_yr:Herb       1347243   67362    20 250.980  0.6350 0.8845826
## Soil:Herb                634435   79304     8 250.980  0.7476 0.6493373
## Site_crop_yr:Soil:Herb  4945923  123648    40 250.979  1.1657 0.2403375
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#Site_crop_yr:Soil  2- way interacion significant

SByield= emmeans(SB.Mod1 ,~ Soil|Site_crop_yr, contr="pairwise", adjust="none", type="response")
```

```
## NOTE: Results may be misleading due to involvement in interactions
```

```
SByieldCLD<- CLD(SByield, alpha=0.05, Letters=letters, adjust="none", sort=TRUE, reverse=TRUE)
```

```
## Warning: 'CLD' will be deprecated. Its use is discouraged.
## See '? CLD' for an explanation. Use 'pwpp' or 'multcomp::cld' instead.

## Warning in CLD.emm_list(SByield, alpha = 0.05, Letters = letters, adjust =
## "none", : `CLD()` called with a list of 2 objects. Only the first one was used.

## Warning: 'CLD' will be deprecated. Its use is discouraged.
## See '? CLD' for an explanation. Use 'pwpp' or 'multcomp::cld' instead.
```

```
SByieldCLD
```

```
## Site_crop_yr = ARL_SB_19:
##  Soil  emmean  SE   df lower.CL upper.CL .group
##  Till    3698 159 24.3     3371     4026  a
##  NT+CC   3632 159 24.3     3304     3959  a
##  NT      3609 159 24.3     3282     3937  a
##
## Site_crop_yr = ARL_SB_20:
##  Soil  emmean  SE   df lower.CL upper.CL .group
##  NT      4131 159 24.3     3803     4458  a
##  NT+CC   4012 159 24.3     3685     4340  a
##  Till    3979 159 24.3     3652     4306  a
##
## Site_crop_yr = HAV_SB_19:
##  Soil  emmean  SE   df lower.CL upper.CL .group
##  NT+CC   3431 159 24.3     3103     3758  a
##  NT      3322 159 24.3     2995     3649  a
##  Till    3287 159 24.3     2960     3615  a
##
## Site_crop_yr = HAV_SB_20:
##  Soil  emmean  SE   df lower.CL upper.CL .group
##  Till    3179 159 24.3     2851     3506  a
##  NT+CC   3153 159 24.3     2825     3480  a
##  NT      3097 159 24.3     2770     3424  a
##
## Site_crop_yr = LAN_SB_19:
##  Soil  emmean  SE   df lower.CL upper.CL .group
##  Till    5015 159 24.3     4688     5342  a
##  NT      4870 159 24.3     4542     5197  a
##  NT+CC   4469 160 25.0     4140     4798   b
##
## Site_crop_yr = LAN_SB_20:
##  Soil  emmean  SE   df lower.CL upper.CL .group
##  NT      4696 159 24.3     4369     5023  a
##  Till    4659 159 24.3     4332     4986  a
##  NT+CC   4656 159 24.3     4328     4983  a
##
## Results are averaged over the levels of: Herb
## Degrees-of-freedom method: kenward-roger
## Confidence level used: 0.95
## significance level used: alpha = 0.05
```

Cover crop treatment reduced yield at Lancaster in 2019. Yield was the same in all other studies.

Soybean Canopy Coverage

```
Soybean1= Soybean1 %>%
  mutate(CNcanopy= Crop.Canopy/100)

SB.Mod2= glmmTMB(CNcanopy~ Site_crop_yr*Soil*Herb + (1|Site_crop_yr:Rep), data=Soybean1, beta_family(li

Anova(CN.Mod2)
```

```
## Analysis of Deviance Table (Type II Wald chisquare tests)
##
## Response: CNcanopy
##                            Chisq Df Pr(>Chisq)
## Site_crop_yr           1543.2035  4  < 2.2e-16 ***
## Soil                     16.7228  2  0.0002337 ***
## Herb                     12.3376  4  0.0150097 *
## Site_crop_yr:Soil        33.2584  8  5.532e-05 ***
## Site_crop_yr:Herb        18.9533 16  0.2710912
## Soil:Herb                 7.4963  8  0.4841468
## Site_crop_yr:Soil:Herb   22.3448 32  0.8979091
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#Site_crop_yr:Soil 2-way interaction and Herb fixed effect significant.

SBcanopy= emmeans(SB.Mod2 ,~ Soil|Site_crop_yr, contr="pairwise", adjust="none", type="response")
```

```
## NOTE: Results may be misleading due to involvement in interactions
```

```
SBcanopyCLD<- CLD(SBcanopy, alpha=0.05, Letters=letters, adjust="none", sort=TRUE, reverse=TRUE)
```

```
## Warning: 'CLD' will be deprecated. Its use is discouraged.
## See '? CLD' for an explanation. Use 'pwpp' or 'multcomp::cld' instead.

## Warning in CLD.emm_list(SBcanopy, alpha = 0.05, Letters = letters, adjust =
## "none", : `CLD()` called with a list of 2 objects. Only the first one was used.

## Warning: 'CLD' will be deprecated. Its use is discouraged.
## See '? CLD' for an explanation. Use 'pwpp' or 'multcomp::cld' instead.
```

```
SBcanopyCLD
```

```
## Site_crop_yr = ARL_SB_19:
##  Soil  response      SE  df lower.CL upper.CL .group
##  Till    0.1445 0.01075 268   0.1246   0.1670  a
##  NT      0.1108 0.00871 268   0.0948   0.1291   b
##  NT+CC   0.1060 0.00841 268   0.0905   0.1237   b
##
## Site_crop_yr = ARL_SB_20:
##  Soil  response      SE  df lower.CL upper.CL .group
```

```
##  NT      0.2771 0.01697 268   0.2450   0.3117  a
##  Till    0.2658 0.01655 268   0.2345   0.2996  a
##  NT+CC   0.2644 0.01650 268   0.2333   0.2982  a
##
## Site_crop_yr = HAV_SB_19:
##  Soil  response      SE  df lower.CL upper.CL .group
##  Till    0.1110 0.00872 268   0.0949   0.1293  a
##  NT+CC   0.0929 0.00755 268   0.0791   0.1089   b
##  NT      0.0850 0.00703 268   0.0722   0.0999   b
##
## Site_crop_yr = HAV_SB_20:
##  Soil  response      SE  df lower.CL upper.CL .group
##  Till    0.0848 0.00701 268   0.0720   0.0997  a
##  NT      0.0724 0.00616 268   0.0612   0.0855   b
##  NT+CC   0.0719 0.00612 268   0.0607   0.0849   b
##
## Site_crop_yr = LAN_SB_19:
##  Soil  response      SE  df lower.CL upper.CL .group
##  Till    0.1358 0.01024 268   0.1169   0.1573  a
##  NT      0.1028 0.00820 268   0.0878   0.1201   b
##  NT+CC   0.0922 0.00751 268   0.0785   0.1081    c
##
## Site_crop_yr = LAN_SB_20:
##  Soil  response      SE  df lower.CL upper.CL .group
##  NT+CC   0.2521 0.01602 268   0.2218   0.2849  a
##  NT      0.2520 0.01601 268   0.2218   0.2848  a
##  Till    0.2493 0.01590 268   0.2193   0.2819  a
##
## Results are averaged over the levels of: Herb
## Confidence level used: 0.95
## Intervals are back-transformed from the logit scale
## Tests are performed on the log odds ratio scale
## significance level used: alpha = 0.05
```

```
SBcanopyHerb= emmeans(SB.Mod2 ,~ Herb, contr="pairwise", adjust="none", type="response")
```

```
## NOTE: Results may be misleading due to involvement in interactions
```

```
SBcanopyHerbCLD<- CLD(SBcanopyHerb, alpha=0.05, Letters=letters, adjust="none", sort=TRUE, reverse=TRUE)
```

```
## Warning: 'CLD' will be deprecated. Its use is discouraged.
## See '? CLD' for an explanation. Use 'pwpp' or 'multcomp::cld' instead.
```

```
## Warning in CLD.emm_list(SBcanopyHerb, alpha = 0.05, Letters = letters, adjust =
## "none", : `CLD()` called with a list of 2 objects. Only the first one was used.
```

```
## Warning: 'CLD' will be deprecated. Its use is discouraged.
## See '? CLD' for an explanation. Use 'pwpp' or 'multcomp::cld' instead.
```

```
SBcanopyHerbCLD
```

```
##  Herb response      SE  df lower.CL upper.CL .group
##  CL25    0.143 0.00461 268    0.135    0.153  a
##  ME25    0.142 0.00457 268    0.133    0.151  a
##  CTRL    0.139 0.00452 268    0.131    0.149  a
##  CL50    0.139 0.00451 268    0.130    0.148  ab
##  ME50    0.133 0.00436 268    0.125    0.142   b
##
## Results are averaged over the levels of: Site_crop_yr, Soil
## Confidence level used: 0.95
## Intervals are back-transformed from the logit scale
## Tests are performed on the log odds ratio scale
## significance level used: alpha = 0.05
```

Effect on canopy coverage varied by soil treatment between site-years, tillage had increased canopy coverage in 4 out of 6 site years. The high rate of mesotrione reduced canopy coverage.