

# Lathyrus ms2: selection on reaction norms for flowering time

Variation in selection among years using BLUPs

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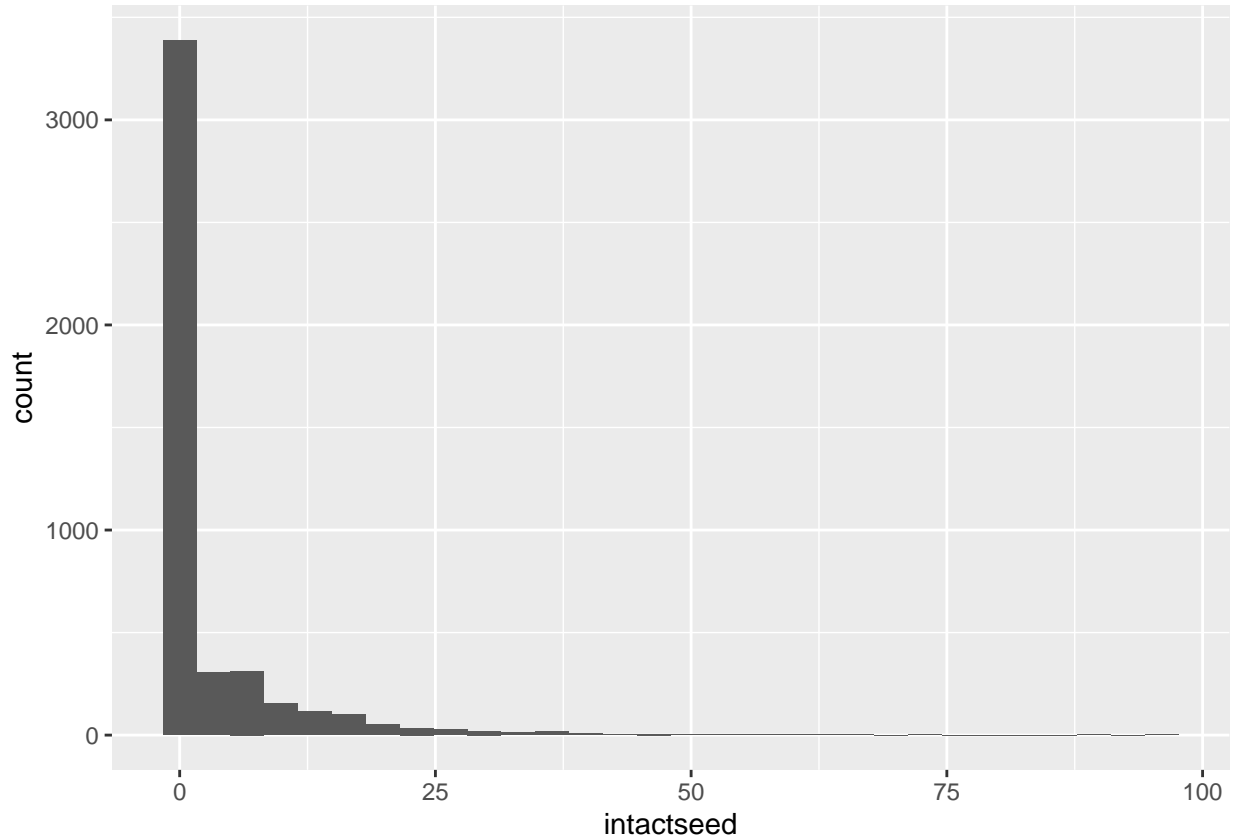
## Read data and check ns

```
datadef_BLUPs<-read.csv("data/datadef_BLUPs.csv")
head(datadef_BLUPs)
```

```
##   year id_nr   id fcode      FFD n_fl n_fr totseed intactseed shoot_vol period
## 1 1989    1 old_1     1      NA    6   3        8          6 1418.6000   old
## 2 1990    1 old_1     0      NA    0   0         0          0 523.2000   old
## 3 1991    1 old_1     1 59.91181 23   3       12         12 1915.4000   old
## 4 1992    1 old_1     1 55.66944 19   2         6          1 1460.1917   old
## 5 1993    1 old_1     1      NA   NA   0         0          0 879.6493   old
## 6 1994    1 old_1     1 59.18403 14   1         3          3 1338.6727   old
##   n_years_fl_fitness n_years_study   mean_4      cmean_4 intercept      slope
## 1                   5                8 5.236667 -0.228207783 -0.7399266 -0.2018749
## 2                   5                8 7.195000  1.730125551 -0.7399266 -0.2018749
## 3                   5                8 5.245000 -0.219874449 -0.7399266 -0.2018749
## 4                   5                8 3.828333 -1.636541116 -0.7399266 -0.2018749
## 5                   5                8 5.461667 -0.003207783 -0.7399266 -0.2018749
## 6                   5                8 6.418333  0.953458884 -0.7399266 -0.2018749
##   mean_fitness_study mean_fitness_fl cn_shoot_vol_mean_sqrt
## 1                 2.75                4.4                3.382001
## 2                 2.75                4.4                3.382001
## 3                 2.75                4.4                3.382001
## 4                 2.75                4.4                3.382001
```

|      |      |     |          |
|------|------|-----|----------|
| ## 5 | 2.75 | 4.4 | 3.382001 |
| ## 6 | 2.75 | 4.4 | 3.382001 |

```
ggplot(datadef_BLUPs,aes(x=intactseed))+geom_histogram()
```



## Models with glmmTMB

### Temp\*slope

Trying different distributions and models with and without zero-inflation

```
# Models without zero-inflation
modelBLUP_1_1<-glmmTMB(round(intactseed)~slope*cmean_4+(1|id),family="poisson",
  data=datadef_BLUPs)
modelBLUP_1_2<-glmmTMB(round(intactseed)~slope*cmean_4+(1|id),family="nbinom2",
  data=datadef_BLUPs)
# Models with zero-inflation
modelBLUP_1_3<-glmmTMB(formula=round(intactseed)~slope*cmean_4+(1|id),
  ziformula=~.,family="poisson",data=datadef_BLUPs)
modelBLUP_1_4<-glmmTMB(formula=round(intactseed)~slope*cmean_4+(1|id),
  ziformula=~.,family="nbinom2",data=datadef_BLUPs)
```

```
AIC(modelBLUP_1_1,modelBLUP_1_2,modelBLUP_1_3,modelBLUP_1_4)
```

```
##           df      AIC
## modelBLUP_1_1  5 36640.88
## modelBLUP_1_2  6 14232.09
## modelBLUP_1_3 10 16916.64
## modelBLUP_1_4 11 13678.81
```

```
anova(modelBLUP_1_1,modelBLUP_1_2,modelBLUP_1_3,modelBLUP_1_4)
```

```
## Data: datadef_BLUPs
## Models:
## modelBLUP_1_1: round(intactseed) ~ slope * cmean_4 + (1 | id), zi=~0, disp=~1
## modelBLUP_1_2: round(intactseed) ~ slope * cmean_4 + (1 | id), zi=~0, disp=~1
## modelBLUP_1_3: round(intactseed) ~ slope * cmean_4 + (1 | id), zi=~., disp=~1
## modelBLUP_1_4: round(intactseed) ~ slope * cmean_4 + (1 | id), zi=~., disp=~1
##           Df   AIC   BIC  logLik deviance  Chisq Chi Df Pr(>Chisq)
## modelBLUP_1_1  5 36641 36673 -18315.4    36631
## modelBLUP_1_2  6 14232 14271  -7110.0    14220 22410.8      1    <2e-16 ***
## modelBLUP_1_3 10 16917 16981  -8448.3    16897      0.0      4      1
## modelBLUP_1_4 11 13679 13750  -6828.4    13657  3239.8      1    <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

modelBLUP\_1\_4 with a zero-inflated negative binomial is the best model.

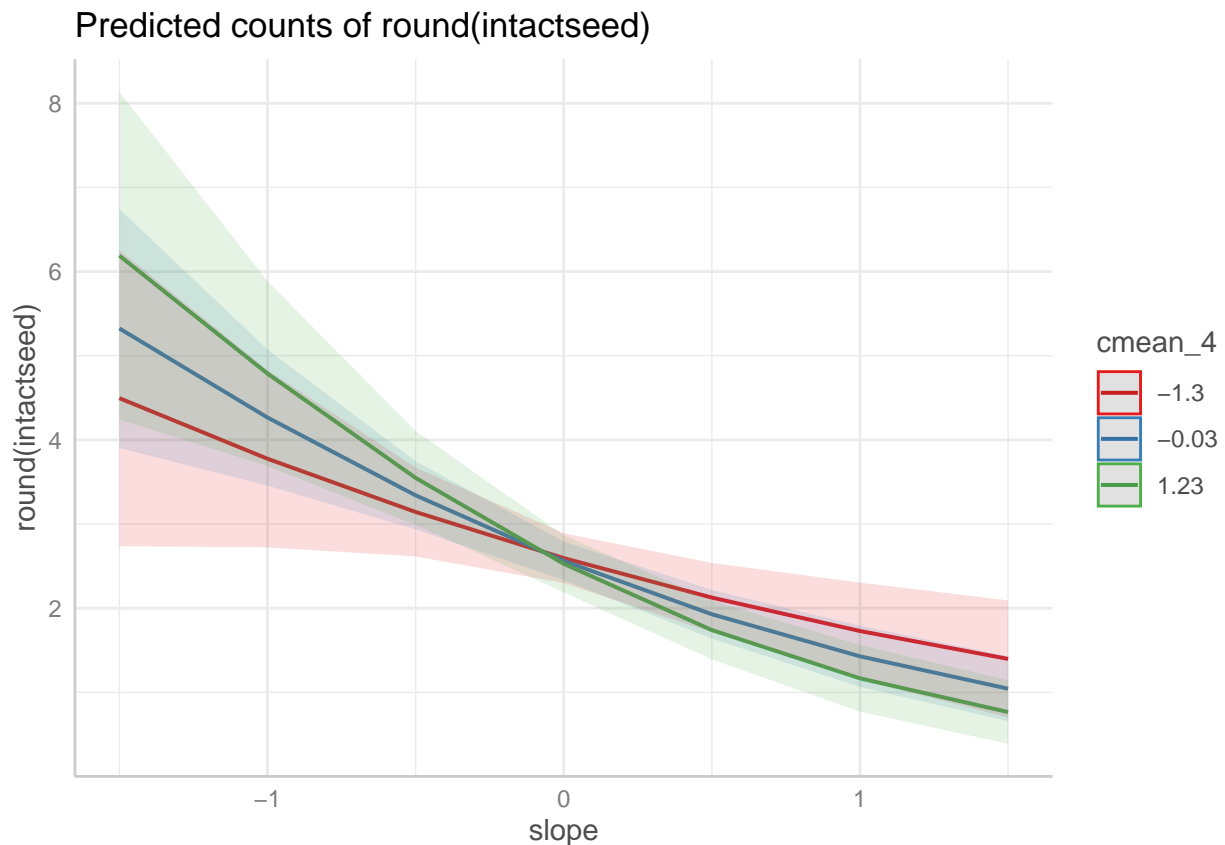
```
summary(modelBLUP_1_4)
```

```
## Family: nbinom2 ( log )
## Formula:          round(intactseed) ~ slope * cmean_4 + (1 | id)
## Zero inflation:          ~.
## Data: datadef_BLUPs
##
##           AIC      BIC  logLik deviance df.resid
## 13678.8 13749.5 -6828.4 13656.8    4556
##
## Random effects:
##
## Conditional model:
## Groups Name      Variance Std.Dev.
## id      (Intercept) 0.1092  0.3305
## Number of obs: 4567, groups: id, 837
##
## Zero-inflation model:
## Groups Name      Variance Std.Dev.
## id      (Intercept) 0.2225  0.4717
## Number of obs: 4567, groups: id, 837
##
## Overdispersion parameter for nbinom2 family (): 1.51
##
## Conditional model:
```

```
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)    2.22247    0.032954  67.43  <2e-16 ***
## slope         -0.107770   0.073504  -1.47   0.143
## cmean_4        0.030970   0.027288   1.13   0.256
## slope:cmean_4  0.007192   0.056831   0.13   0.899
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Zero-inflation model:
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)    0.95657    0.04302  22.234 < 2e-16 ***
## slope          0.61819    0.10380   5.956 2.59e-09 ***
## cmean_4        0.05735    0.02908   1.972 0.04858 *
## slope:cmean_4  0.17722    0.06774   2.616 0.00889 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

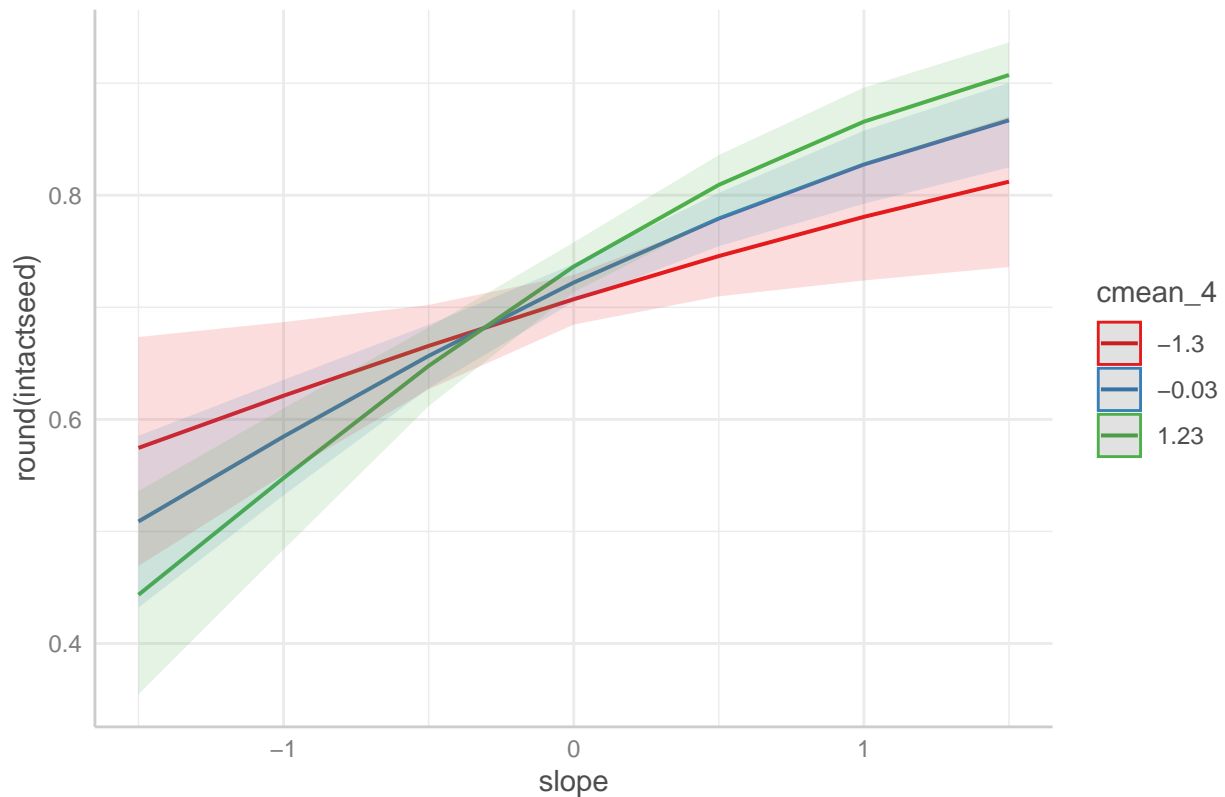
Predicted effects:

```
plot(ggpredict(modelBLUP_1_4,terms=c("slope","cmean_4"),type="zero_inflated"))
```



```
# Predicted values are conditioned on the fixed effects
# and the zero-inflation component
plot(ggpredict(modelBLUP_1_4,terms=c("slope","cmean_4"),type="zi_prob"))
```

## Predicted zero-inflation probabilities of round(intactseed)



*# Predicted zero-inflation probability*

Selection for plasticity (more negative slopes) increases with temperature, but this is only driven by the zero-inflated part of the model, i.e. the probability of fitness being zero decreases more with higher plasticity (more negative slopes) with warm temperatures.

## Temp\*slope+volume

Trying different distributions and models with and without zero-inflation

```
# Models without zero-inflation
modelBLUP_2_1<-glmmTMB(round(intactseed)~slope*cmean_4+cn_shoot_vol_mean_sqrt+
  (1|id),family="poisson",data=datadef_BLUPs)
modelBLUP_2_2<-glmmTMB(round(intactseed)~slope*cmean_4+cn_shoot_vol_mean_sqrt+
  (1|id),family="nbinom2",data=datadef_BLUPs)
# Models with zero-inflation
modelBLUP_2_3<-glmmTMB(formula=round(intactseed)~slope*cmean_4+
  cn_shoot_vol_mean_sqrt+(1|id),ziformula=~.,
  family="poisson",data=datadef_BLUPs)
modelBLUP_2_4<-glmmTMB(formula=round(intactseed)~slope*cmean_4+
  cn_shoot_vol_mean_sqrt+(1|id),ziformula=~.,
  family="nbinom2",data=datadef_BLUPs)
```

```
AIC(modelBLUP_2_1,modelBLUP_2_2,modelBLUP_2_3,modelBLUP_2_4)
```

```
##           df      AIC
## modelBLUP_2_1  6 36242.03
## modelBLUP_2_2  7 13858.00
## modelBLUP_2_3 12 16428.25
## modelBLUP_2_4 13 13217.08
```

```
anova(modelBLUP_2_1,modelBLUP_2_2,modelBLUP_2_3,modelBLUP_2_4)
```

```
## Data: datadef_BLUPs
## Models:
## modelBLUP_2_1: round(intactseed) ~ slope * cmean_4 + cn_shoot_vol_mean_sqrt + , zi=~0, disp=~1
## modelBLUP_2_1:      (1 | id), zi=~0, disp=~1
## modelBLUP_2_2: round(intactseed) ~ slope * cmean_4 + cn_shoot_vol_mean_sqrt + , zi=~., disp=~1
## modelBLUP_2_2:      (1 | id), zi=~., disp=~1
## modelBLUP_2_3: round(intactseed) ~ slope * cmean_4 + cn_shoot_vol_mean_sqrt + , zi=~0, disp=~1
## modelBLUP_2_3:      (1 | id), zi=~0, disp=~1
## modelBLUP_2_4: round(intactseed) ~ slope * cmean_4 + cn_shoot_vol_mean_sqrt + , zi=~., disp=~1
## modelBLUP_2_4:      (1 | id), zi=~., disp=~1
##           Df    AIC    BIC   logLik deviance   Chisq Chi Df Pr(>Chisq)
## modelBLUP_2_1  6 36242 36281 -18115.0    36230
## modelBLUP_2_2  7 13858 13903  -6922.0    13844 22386.0      1    <2e-16 ***
## modelBLUP_2_3 12 16428 16505  -8202.1    16404      0.0      5      1
## modelBLUP_2_4 13 13217 13300  -6595.5    13191  3213.2      1    <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

modelBLUP\_2\_4 with a zero-inflated negative binomial is the best model.

```
summary(modelBLUP_2_4)
```

```
## Family: nbinom2 ( log )
## Formula:
## round(intactseed) ~ slope * cmean_4 + cn_shoot_vol_mean_sqrt +      (1 | id)
## Zero inflation:      ~.
## Data: datadef_BLUPs
##
##           AIC      BIC   logLik deviance df.resid
## 13217.1 13300.5 -6595.5 13191.1      4508
##
## Random effects:
##
## Conditional model:
## Groups Name      Variance Std.Dev.
## id      (Intercept) 0.06163  0.2483
## Number of obs: 4521, groups: id, 791
##
## Zero-inflation model:
## Groups Name      Variance Std.Dev.
## id      (Intercept) 0.03276  0.181
```

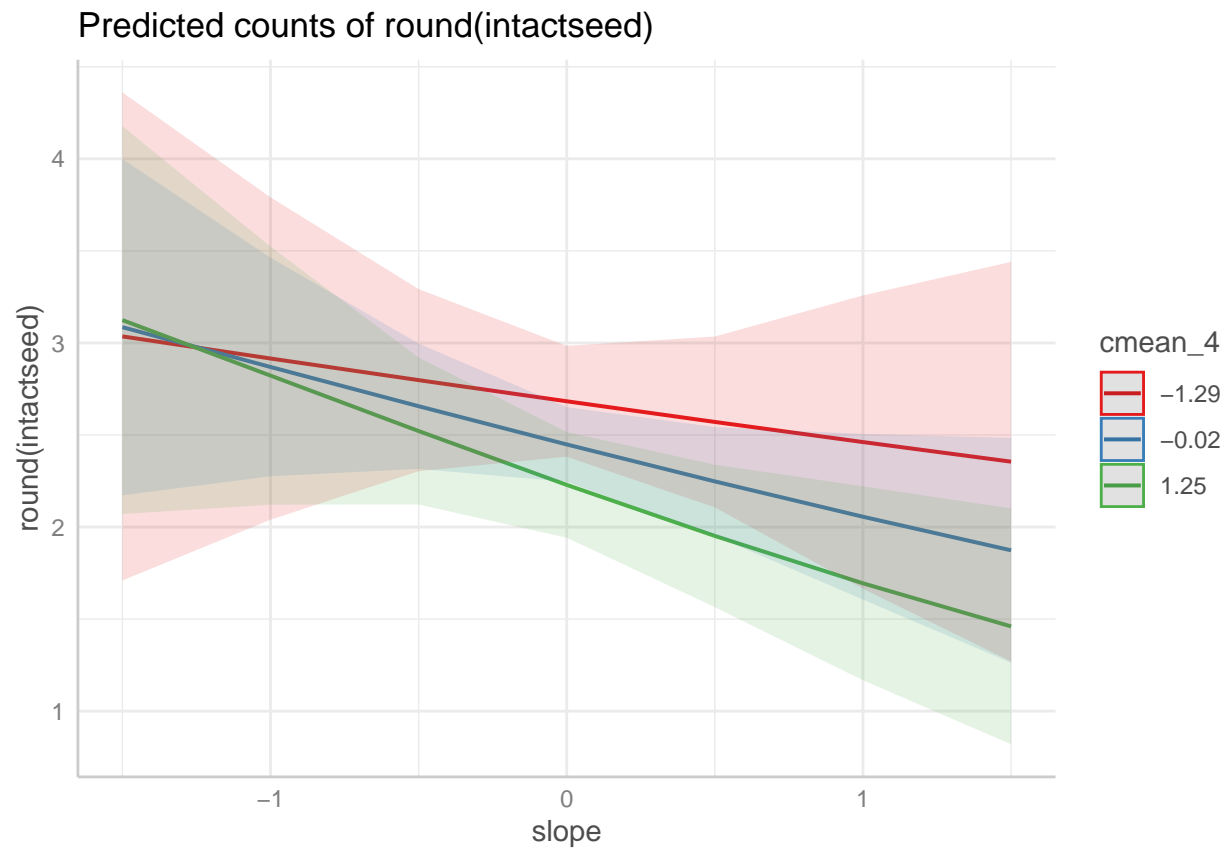
```

## Number of obs: 4521, groups: id, 791
##
## Overdispersion parameter for nbinom2 family (): 1.55
##
## Conditional model:
##
##           Estimate Std. Error z value Pr(>|z|)
## (Intercept)      2.148359   0.032576  65.95  <2e-16 ***
## slope            0.038629   0.070660   0.55   0.585
## cmean_4          -0.008609   0.026862  -0.32   0.749
## cn_shoot_vol_mean_sqrt 0.018059   0.002250   8.03  1e-15 ***
## slope:cmean_4      0.029863   0.056962   0.52   0.600
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Zero-inflation model:
##
##           Estimate Std. Error z value Pr(>|z|)
## (Intercept)      1.009310   0.039990  25.239 < 2e-16 ***
## slope            0.286781   0.093310   3.073 0.00212 **
## cmean_4          0.089293   0.028868   3.093 0.00198 **
## cn_shoot_vol_mean_sqrt -0.039385   0.003141 -12.539 < 2e-16 ***
## slope:cmean_4      0.128201   0.066327   1.933 0.05325 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

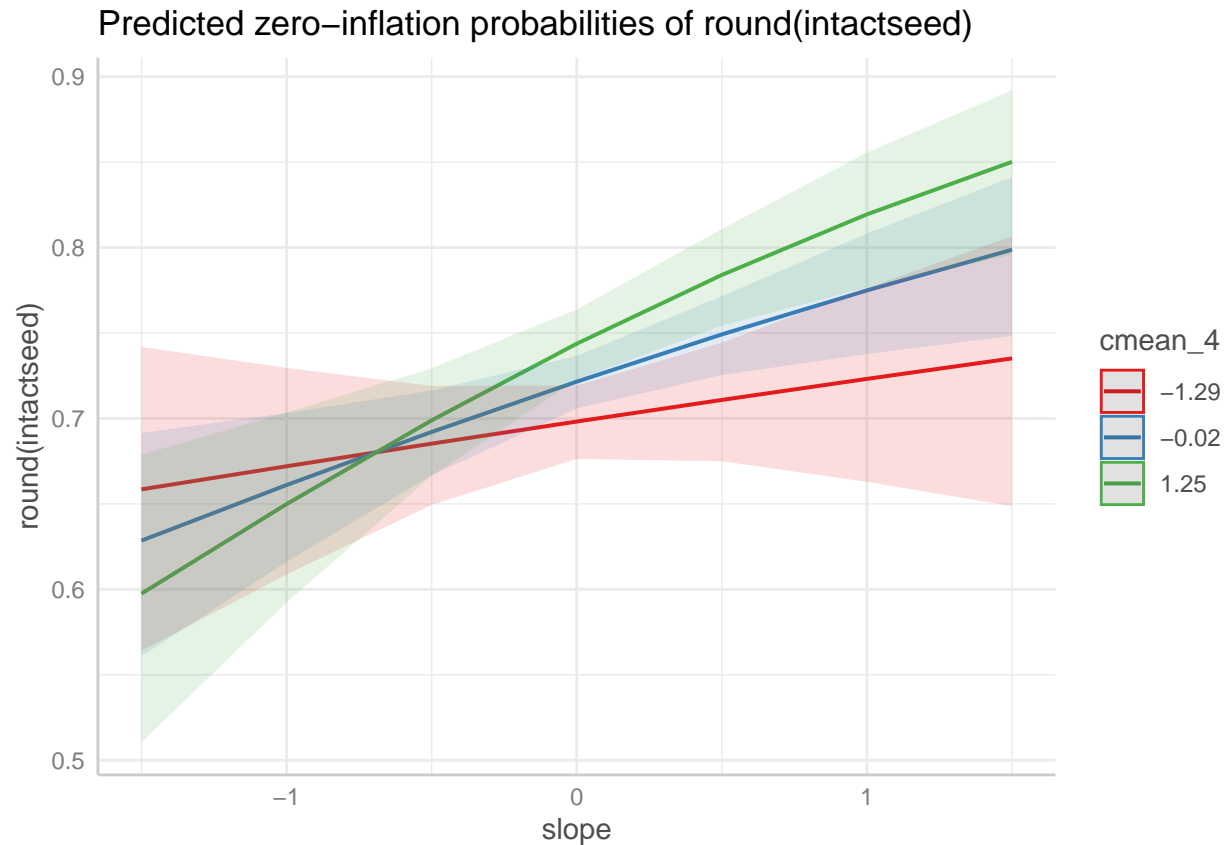
Predicted effects:

```
plot(ggpredict(modelBLUP_2_4,terms=c("slope","cmean_4"),type="zero_inflated"))
```



```
# Predicted values are conditioned on the fixed effects  
# and the zero-inflation component  
plot(ggpredict(modelBLUP_2_4, terms=c("slope", "cmean_4"), type="zi_prob"))
```





```
# Predicted zero-inflation probability
```

The interaction slope:temperature in the zero-inflation part of the model is not significant ( $p=0.053$ ) when including volume.

## Volume\*slope

Trying different distributions and models with and without zero-inflation

```
# Models without zero-inflation
modelBLUP_3_1<-glmmTMB(round(intactseed)~slope*cn_shoot_vol_mean_sqrt+cmean_4+
  (1|id),family="poisson",data=datadef_BLUPs)
modelBLUP_3_2<-glmmTMB(round(intactseed)~slope*cn_shoot_vol_mean_sqrt+cmean_4+
  (1|id),family="nbinom2",data=datadef_BLUPs)
# Models with zero-inflation
modelBLUP_3_3<-glmmTMB(formula=round(intactseed)~slope*cn_shoot_vol_mean_sqrt+
  cmean_4+(1|id),ziformula=~.,
  family="poisson",data=datadef_BLUPs)
modelBLUP_3_4<-glmmTMB(formula=round(intactseed)~slope*cn_shoot_vol_mean_sqrt+
  cmean_4+(1|id),ziformula=~.,
  family="nbinom2",data=datadef_BLUPs)
```

```
AIC(modelBLUP_3_1,modelBLUP_3_2,modelBLUP_3_3,modelBLUP_3_4)
```

```
##           df      AIC
## modelBLUP_3_1  6 36268.42
## modelBLUP_3_2  7 13837.36
## modelBLUP_3_3 12 16401.26
## modelBLUP_3_4 13 13190.45
```

```
anova(modelBLUP_3_1,modelBLUP_3_2,modelBLUP_3_3,modelBLUP_3_4)
```

```
## Data: datadef_BLUPs
## Models:
## modelBLUP_3_1: round(intactseed) ~ slope * cn_shoot_vol_mean_sqrt + cmean_4 + , zi=~0, disp=~1
## modelBLUP_3_1:      (1 | id), zi=~0, disp=~1
## modelBLUP_3_2: round(intactseed) ~ slope * cn_shoot_vol_mean_sqrt + cmean_4 + , zi=~., disp=~1
## modelBLUP_3_2:      (1 | id), zi=~., disp=~1
## modelBLUP_3_3: round(intactseed) ~ slope * cn_shoot_vol_mean_sqrt + cmean_4 + , zi=~0, disp=~1
## modelBLUP_3_3:      (1 | id), zi=~0, disp=~1
## modelBLUP_3_4: round(intactseed) ~ slope * cn_shoot_vol_mean_sqrt + cmean_4 + , zi=~., disp=~1
## modelBLUP_3_4:      (1 | id), zi=~., disp=~1
##           Df    AIC    BIC   logLik deviance   Chisq Chi Df Pr(>Chisq)
## modelBLUP_3_1  6 36268 36307 -18128.2    36256
## modelBLUP_3_2  7 13837 13882  -6911.7    13823 22433.1     1    <2e-16 ***
## modelBLUP_3_3 12 16401 16478  -8188.6    16377     0.0     5      1
## modelBLUP_3_4 13 13190 13274  -6582.2    13164  3212.8     1    <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

modelBLUP\_3\_4 with a zero-inflated negative binomial is the best model.

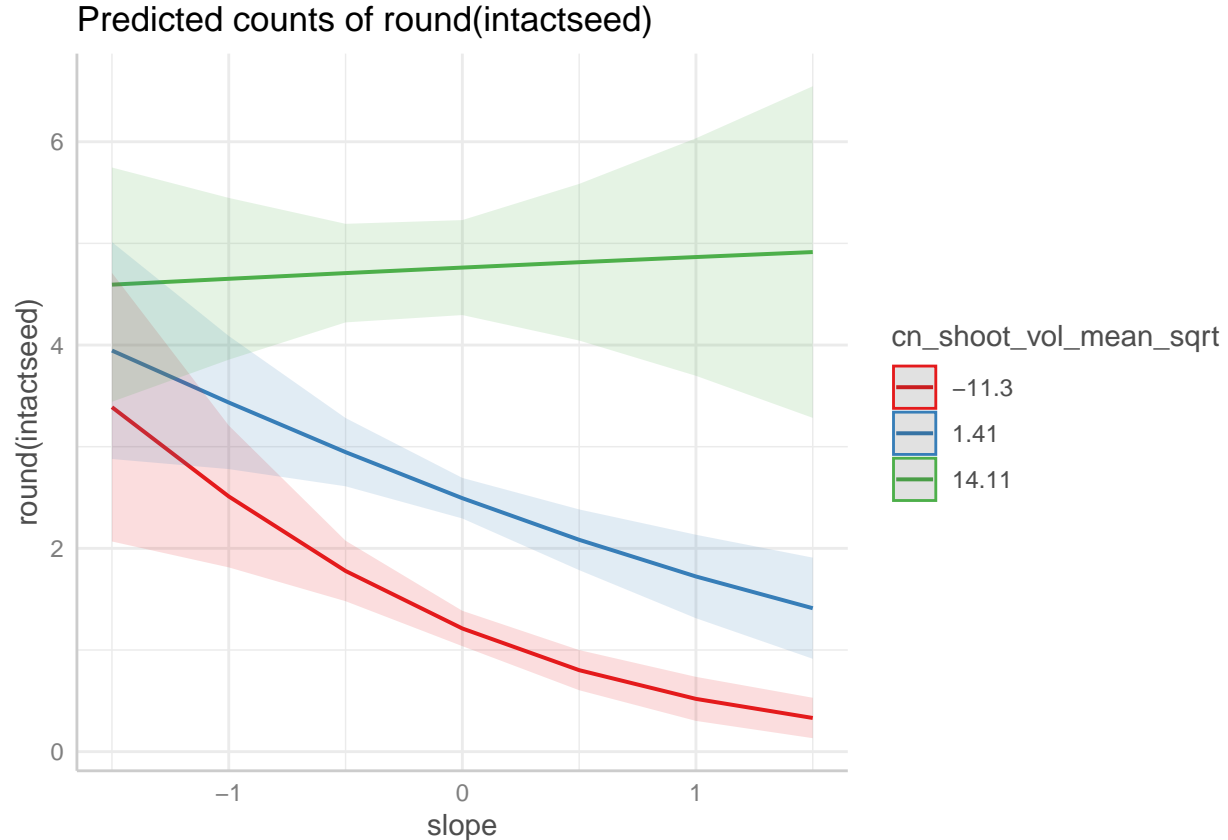
```
summary(modelBLUP_3_4)
```

```
## Family: nbinom2 ( log )
## Formula:
## round(intactseed) ~ slope * cn_shoot_vol_mean_sqrt + cmean_4 +      (1 | id)
## Zero inflation:      ~.
## Data: datadef_BLUPs
##
##           AIC          BIC   logLik deviance df.resid
## 13190.5 13273.9 -6582.2 13164.5     4508
##
## Random effects:
##
## Conditional model:
## Groups Name          Variance Std.Dev.
## id      (Intercept) 0.06077  0.2465
## Number of obs: 4521, groups: id, 791
##
## Zero-inflation model:
## Groups Name          Variance Std.Dev.
## id      (Intercept) 0.01006  0.1003
## Number of obs: 4521, groups: id, 791
##
## Overdispersion parameter for nbinom2 family (): 1.55
```

```
##
## Conditional model:
##
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)      2.1442202   0.0324626   66.05 < 2e-16 ***
## slope            -0.0005154   0.0796378   -0.01  0.995
## cn_shoot_vol_mean_sqrt  0.0199449   0.0027729    7.19 6.35e-13 ***
## cmean_4          -0.0113220   0.0264956   -0.43  0.669
## slope:cn_shoot_vol_mean_sqrt  0.0052959   0.0042958    1.23  0.218
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Zero-inflation model:
##
##               Estimate Std. Error z value Pr(>|z|)
## (Intercept)      0.994118   0.039329   25.277 < 2e-16 ***
## slope            0.538685   0.101859    5.289 1.23e-07 ***
## cn_shoot_vol_mean_sqrt -0.047724   0.003499  -13.640 < 2e-16 ***
## cmean_4          0.083157   0.028532    2.915 0.00356 **
## slope:cn_shoot_vol_mean_sqrt -0.031846   0.005828   -5.464 4.65e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

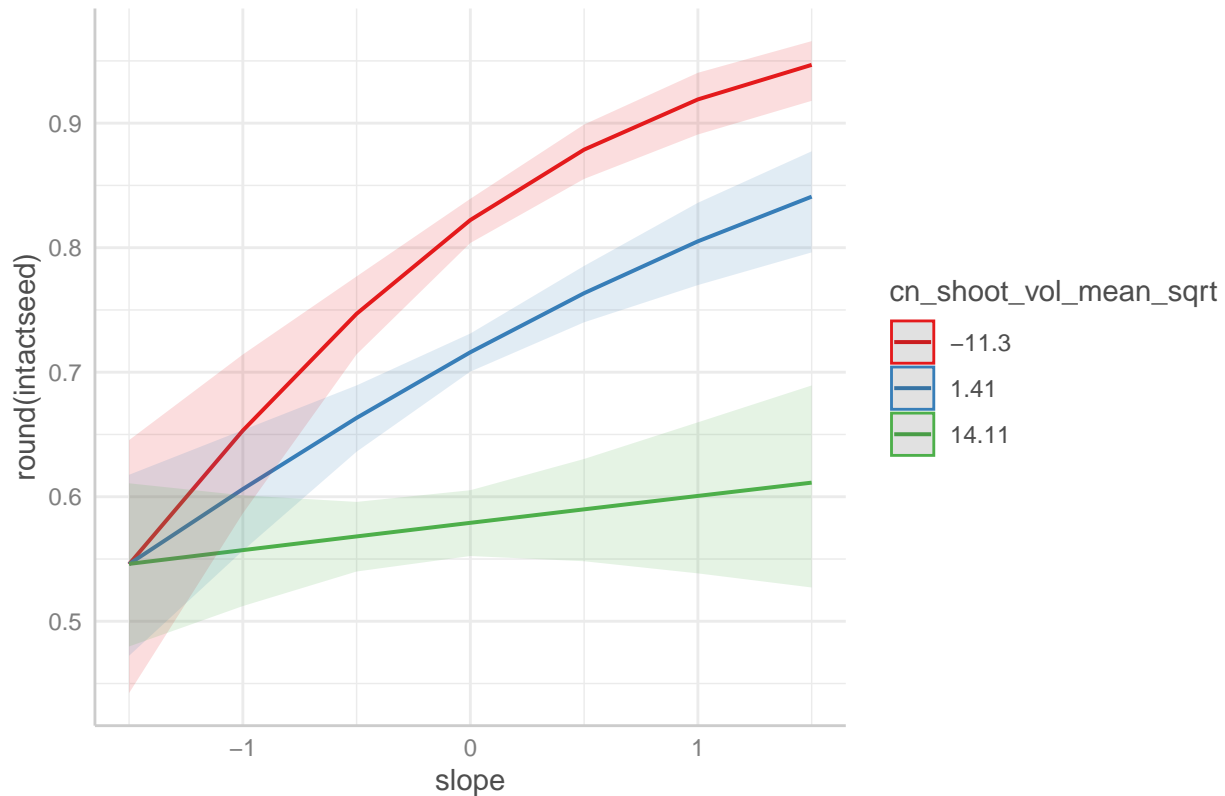
Predicted effects:

```
plot(ggpredict(modelBLUP_3_4,terms=c("slope","cn_shoot_vol_mean_sqrt"),
      type="zero_inflated"))
```



```
# Predicted values are conditioned on the fixed effects
# and the zero-inflation component
plot(ggpredict(modelBLUP_3_4, terms=c("slope", "cn_shoot_vol_mean_sqrt"),
      type="zi_prob"))
```

Predicted zero-inflation probabilities of round(intactseed)



```
# Predicted zero-inflation probability
```

Selection for plasticity (more negative slopes) decreases with size, but this is only driven by the zero-inflated part of the model, i.e. the probability of fitness being zero decreases more with higher plasticity (more negative slopes) with lower sizes.

## Temp $slope + volume$ slope

Trying different distributions and models with and without zero-inflation

```
# Models without zero-inflation
modelBLUP_4_1<-glmmTMB(round(intactseed)~slope*cmean_4+
                        slope*cn_shoot_vol_mean_sqrt+cmean_4+
                        (1|id),family="poisson",data=datadef_BLUPs)
modelBLUP_4_2<-glmmTMB(round(intactseed)~slope*cmean_4+
                        slope*cn_shoot_vol_mean_sqrt+cmean_4+
                        (1|id),family="nbinom2",data=datadef_BLUPs)
# Models with zero-inflation
modelBLUP_4_3<-glmmTMB(formula=round(intactseed)~slope*cmean_4+
```

```

      slope*cn_shoot_vol_mean_sqrt+
      cmean_4+(1|id),ziformula=~.,
      family="poisson",data=datadef_BLUPs)
modelBLUP_4_4<-glmmTMB(formula=round(intactseed)~slope*cmean_4+
      slope*cn_shoot_vol_mean_sqrt+
      cmean_4+(1|id),ziformula=~.,
      family="nbinom2",data=datadef_BLUPs)

```

```
AIC(modelBLUP_4_1,modelBLUP_4_2,modelBLUP_4_3,modelBLUP_4_4)
```

```

##           df      AIC
## modelBLUP_4_1  7 36222.95
## modelBLUP_4_2  8 13838.47
## modelBLUP_4_3 14 16398.95
## modelBLUP_4_4 15 13187.99

```

```
anova(modelBLUP_4_1,modelBLUP_4_2,modelBLUP_4_3,modelBLUP_4_4)
```

```

## Data: datadef_BLUPs
## Models:
## modelBLUP_4_1: round(intactseed) ~ slope * cmean_4 + slope * cn_shoot_vol_mean_sqrt + , zi=~0, disp=
## modelBLUP_4_1:      cmean_4 + (1 | id), zi=~0, disp=~1
## modelBLUP_4_2: round(intactseed) ~ slope * cmean_4 + slope * cn_shoot_vol_mean_sqrt + , zi=~., disp=
## modelBLUP_4_2:      cmean_4 + (1 | id), zi=~., disp=~1
## modelBLUP_4_3: round(intactseed) ~ slope * cmean_4 + slope * cn_shoot_vol_mean_sqrt + , zi=~0, disp=
## modelBLUP_4_3:      cmean_4 + (1 | id), zi=~0, disp=~1
## modelBLUP_4_4: round(intactseed) ~ slope * cmean_4 + slope * cn_shoot_vol_mean_sqrt + , zi=~., disp=
## modelBLUP_4_4:      cmean_4 + (1 | id), zi=~., disp=~1
##           Df    AIC    BIC   logLik deviance Chisq Chi Df Pr(>Chisq)
## modelBLUP_4_1  7 36223 36268 -18104.5    36209
## modelBLUP_4_2  8 13838 13890 -6911.2    13822 22386      1    <2e-16 ***
## modelBLUP_4_3 14 16399 16489 -8185.5    16371      0      6      1
## modelBLUP_4_4 15 13188 13284 -6579.0    13158 3213      1    <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

modelBLUP\_4\_4 with a zero-inflated negative binomial is the best model.

```
summary(modelBLUP_4_4)
```

```

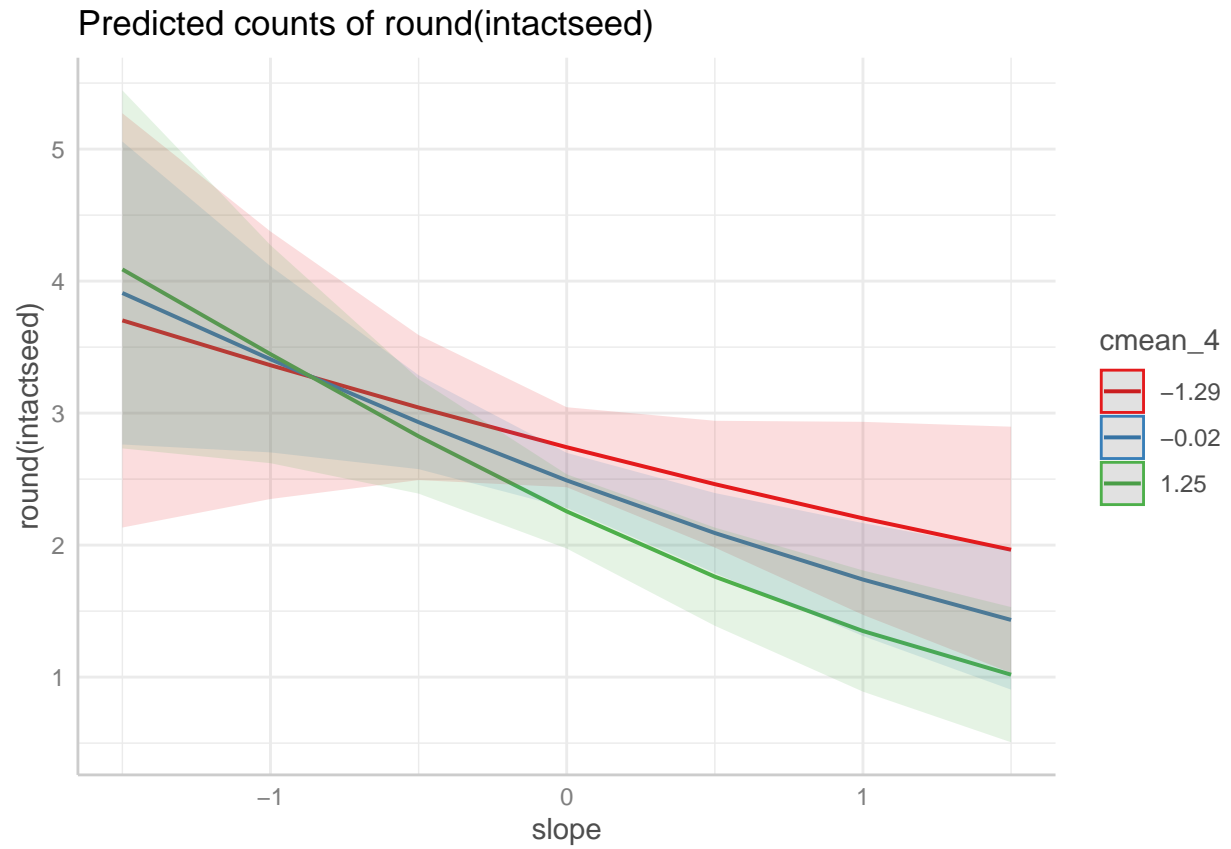
## Family: nbinom2 ( log )
## Formula:
## round(intactseed) ~ slope * cmean_4 + slope * cn_shoot_vol_mean_sqrt +
##      cmean_4 + (1 | id)
## Zero inflation:      ~.
## Data: datadef_BLUPs
##
##           AIC          BIC   logLik deviance df.resid
## 13188.0 13284.2 -6579.0 13158.0      4506
##
## Random effects:

```

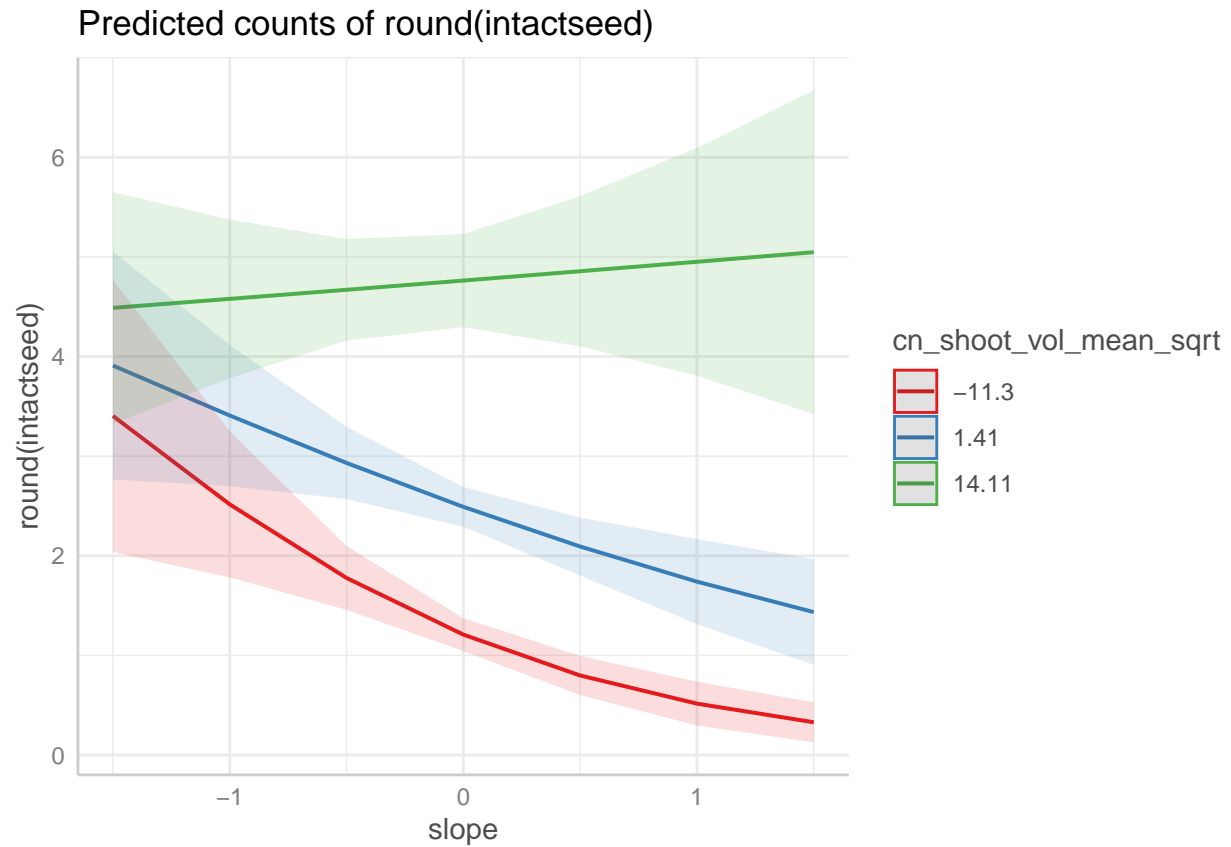
```
##
## Conditional model:
## Groups Name      Variance Std.Dev.
## id      (Intercept) 0.06061  0.2462
## Number of obs: 4521, groups: id, 791
##
## Zero-inflation model:
## Groups Name      Variance Std.Dev.
## id      (Intercept) 0.01064  0.1031
## Number of obs: 4521, groups: id, 791
##
## Overdispersion parameter for nbinom2 family (): 1.55
##
## Conditional model:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)      2.145008   0.032504  65.99 < 2e-16 ***
## slope            -0.005566   0.080259  -0.07  0.945
## cmean_4          -0.009829   0.026835  -0.37  0.714
## cn_shoot_vol_mean_sqrt  0.019948   0.002772   7.20 6.17e-13 ***
## slope:cmean_4      0.025193   0.056538   0.45  0.656
## slope:cn_shoot_vol_mean_sqrt 0.005134   0.004312   1.19  0.234
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Zero-inflation model:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept)      0.996919   0.039441  25.276 < 2e-16 ***
## slope            0.523697   0.102491   5.110 3.23e-07 ***
## cmean_4          0.093577   0.029042   3.222 0.00127 **
## cn_shoot_vol_mean_sqrt -0.047833   0.003509 -13.633 < 2e-16 ***
## slope:cmean_4      0.166706   0.066314   2.514 0.01194 *
## slope:cn_shoot_vol_mean_sqrt -0.033518   0.005872  -5.708 1.14e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Predicted effects:

```
plot(ggpredict(modelBLUP_4_4,terms=c("slope","cmean_4"),type="zero_inflated"))
```

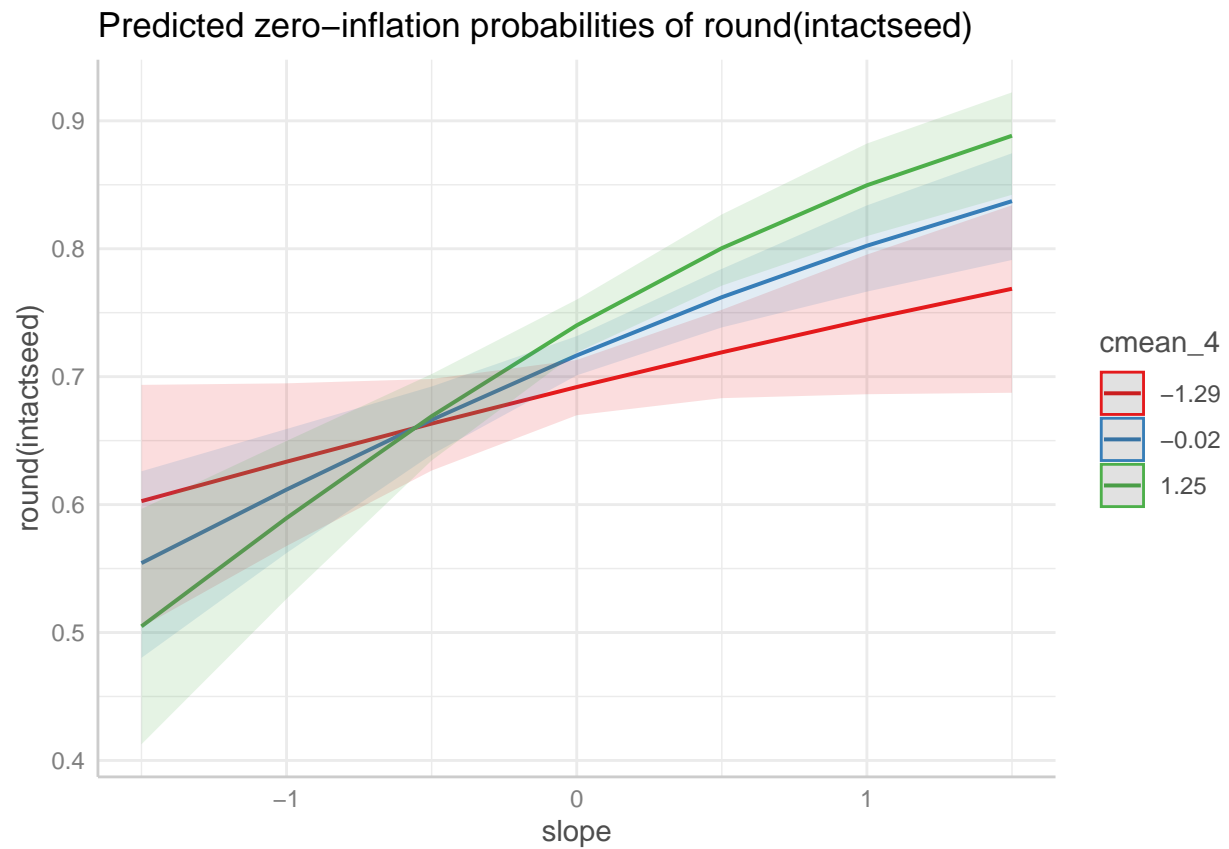


```
plot(ggpredict(modelBLUP_4_4, terms=c("slope", "cn_shoot_vol_mean_sqrt"),  
      type="zero_inflated"))
```



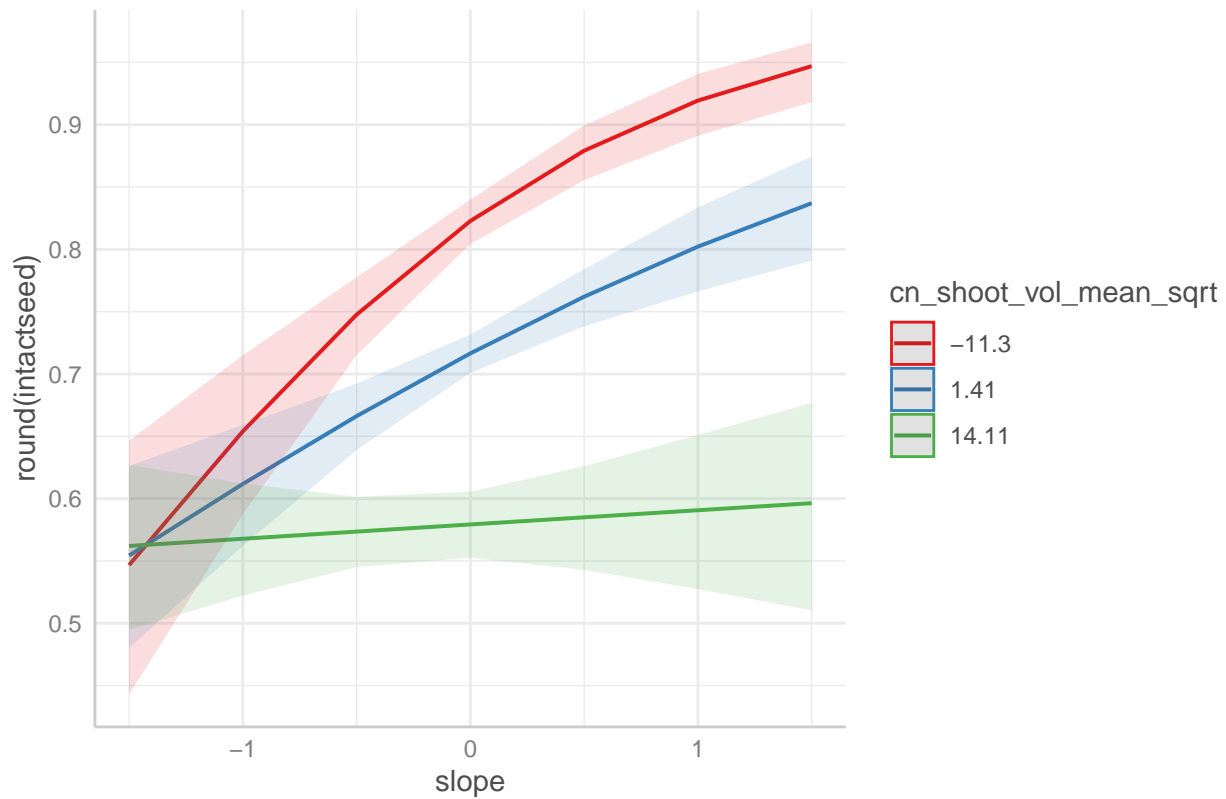
```
# Predicted values are conditioned on the fixed effects  
# and the zero-inflation component  
plot(ggpredict(modelBLUP_4_4, terms=c("slope", "cmean_4"), type="zi_prob"))
```





```
plot(ggpredict(modelBLUP_4_4, terms=c("slope", "cn_shoot_vol_mean_sqrt"),  
      type="zi_prob"))
```

### Predicted zero-inflation probabilities of round(intactseed)



*# Predicted zero-inflation probability*

Similar results as in previous models: Selection for plasticity (more negative slopes) increases with temperature and decreases with size, but this is only driven by the zero-inflated part of the model, i.e. the probability of fitness being zero decreases more with higher plasticity (more negative slopes) with warm temperatures and lower sizes.

**Save large objects as .RData file**