

R Notebook

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##   filter, lag

## The following objects are masked from 'package:base':
##
##   intersect, setdiff, setequal, union

##
## Attaching package: 'gridExtra'

## The following object is masked from 'package:dplyr':
##
##   combine

##
## Attaching package: 'reshape2'

## The following object is masked from 'package:tidyr':
##
##   smiths

## Loading required package: Matrix

##
## Attaching package: 'Matrix'

## The following object is masked from 'package:tidyr':
##
##   expand

##
## Attaching package: 'lmerTest'

## The following object is masked from 'package:lme4':
##
##   lmer

## The following object is masked from 'package:stats':
##
##   step

## Loading required package: estimability

##
## Attaching package: 'lsmeans'

## The following object is masked from 'package:lmerTest':
##
##   lsmeans

Data wrangling

Data = Data %>%
  #select %>% (-Total_kgSoilN_ha) %>%
  mutate(Grain_kgN_ha = Grain_kgdw_ha*Grain_FracN.leco,
```

```

Stover_kgN_ha = Stover_kgdw_ha*Stover_FracN.leco,
Cob_kgN_ha = Cob_kgdw_ha *Stover_FracN.leco,
Final_kgN_ha = Grain_kgN_ha + Stover_kgN_ha + Cob_kgN_ha,
Grain_kgFertN_ha= Grain_FracN_fromFert * grain_FracN*Grain_kgdw_ha,
Stover_kgFertN_ha = Stover_FracN_fromFert * stover_FracN*Stover_kgdw_ha,
Total_kgFertN_ha = Grain_kgFertN_ha + Stover_kgFertN_ha,
Total_kgSoilN_ha = Grain_kgSoilN_ha + Stover_kgSoilN_ha)

```

Physiological maturity

- Testing main effects of fertilizer and year of release
- Including primary experimental plots, i.e. no untreated seed plots and no density comparisons

Biomass

Models

Total Biomass

```

## lme4::lmer(formula = Total_kgdw_ha ~ Fert + R_Year + (1 | Rep) +
##      (1 | Rep:Row:Pos), data = Data, na.action = na.exclude)

## Analysis of Variance Table of type III with Kenward-Roger
## approximation for degrees of freedom
##           Sum Sq   Mean Sq NumDF DenDF F.value    Pr(>F)
## Fert    1072818180 536409090     2    94 190.642 < 2.2e-16 ***
## R_Year   93788125  93788125     1    43  33.333 7.802e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Stover Biomass

```

## lme4::lmer(formula = Stover_kgdw_ha ~ Fert + R_Year + (1 | Rep) +
##      (1 | Rep:Row:Pos), data = Data, na.action = na.exclude)

## Analysis of Variance Table of type III with Kenward-Roger
## approximation for degrees of freedom
##           Sum Sq   Mean Sq NumDF DenDF F.value    Pr(>F)
## Fert    86702495 43351247     2    94  57.325 < 2.2e-16 ***
## R_Year   8160074  8160074     1    43  10.790 0.002034 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Grain Biomass

```

## lme4::lmer(formula = Grain_kgdw_ha ~ Fert * R_Year + (1 | Rep) +
##      (1 | Rep:Row:Pos), data = Data, na.action = na.exclude)

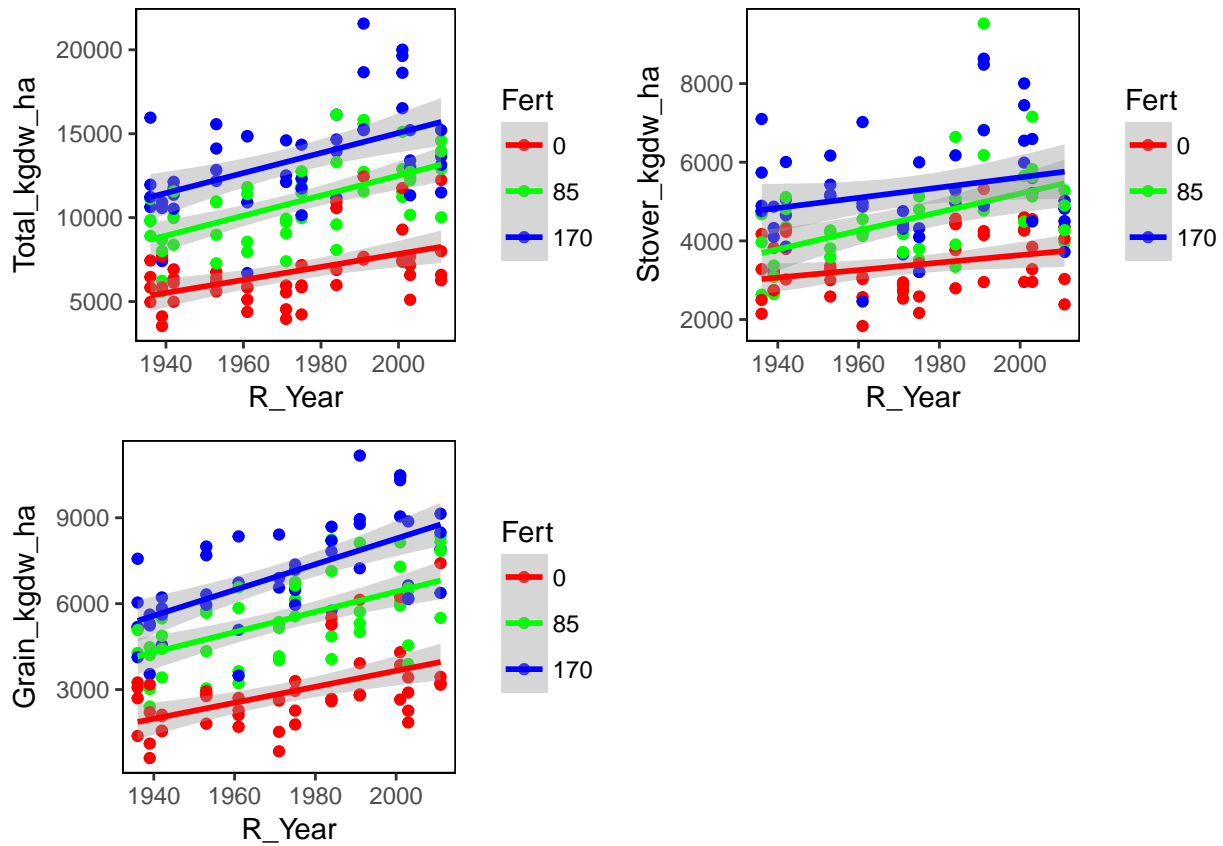
## Analysis of Variance Table of type III with Kenward-Roger
## approximation for degrees of freedom
##           Sum Sq   Mean Sq NumDF DenDF F.value    Pr(>F)
## Fert        3383432  1691716     2    92   2.139  0.12363
## R_Year       39532846 39532846     1    43 49.978 1.021e-08 ***
## Fert:R_Year  4388917  2194458     2    92   2.774  0.06762 .
## ---

```

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

- Fert is not significant when interaction is included, even though it still describes a considerable portion of the variance, probably because of intercept set at R_Year = 0.

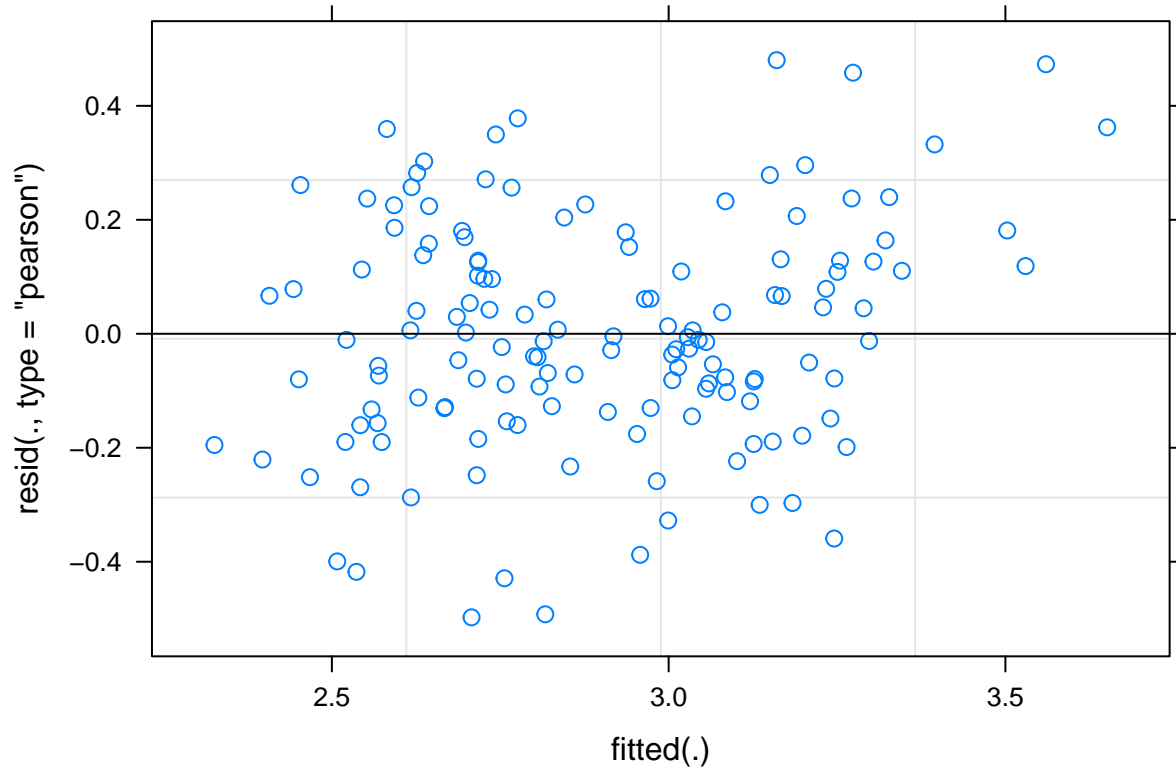
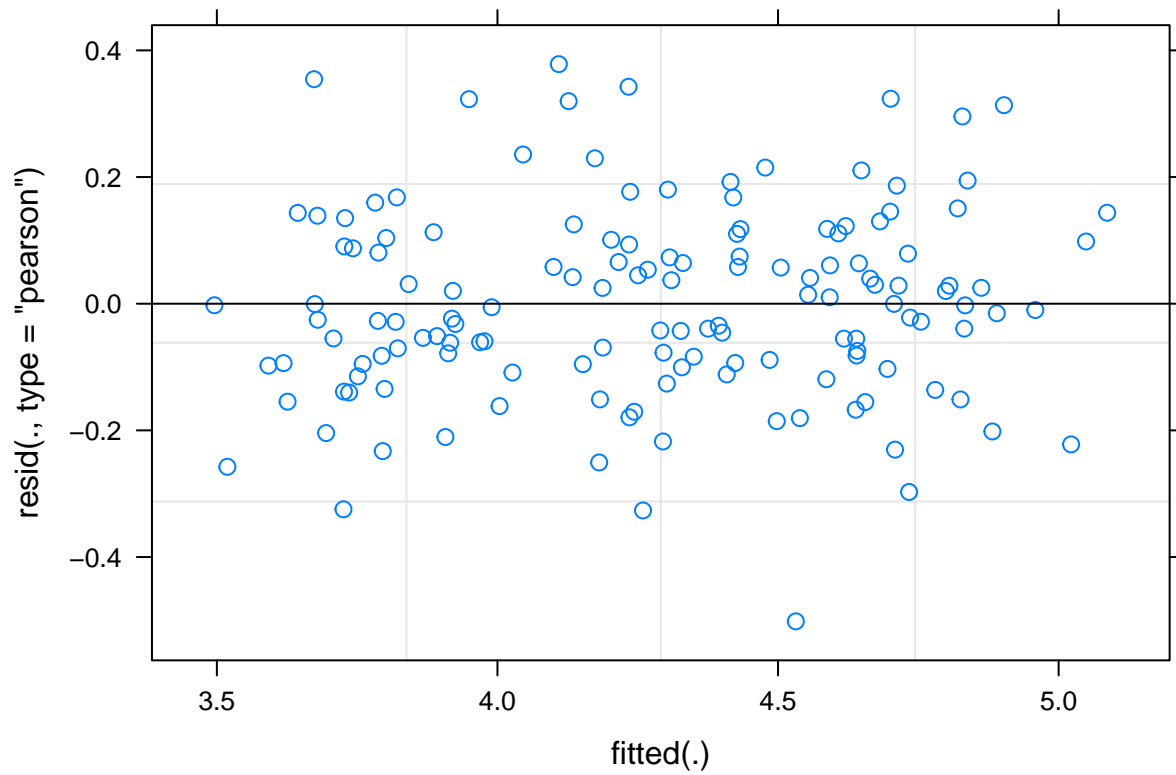
Plotting

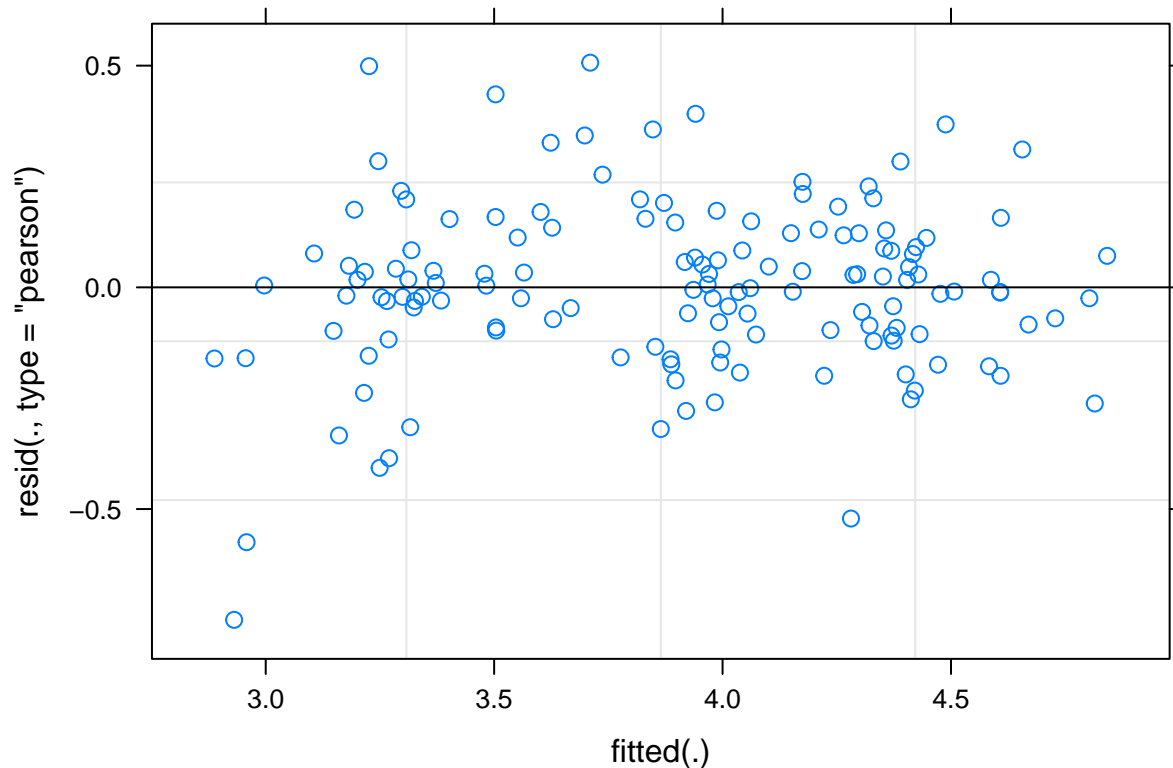


Nuptake

- removing one outlier with inconsistent %N between Davis and Leco

Modeling N uptake





Total N uptake

```
## lme4::lmer(formula = log(Final_kgN_ha) ~ Fert + R_Year + (1 |
##   Rep) + (1 | Rep:Row:Pos), data = sub, na.action = na.exclude)

## Analysis of Variance Table of type III with Kenward-Roger
## approximation for degrees of freedom
##           Sum Sq Mean Sq NumDF  DenDF F.value    Pr(>F)
## Fert      20.0833 10.0417      2  93.325  347.26 < 2.2e-16 ***
## R_Year     0.7876  0.7876      1  42.742   27.24 4.997e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Total N in stover

```
## lme4::lmer(formula = log(Stover_kgN_ha) ~ Fert * R_Year + (1 |
##   Rep) + (1 | Rep:Row:Pos), data = sub, na.action = na.exclude)

## Analysis of Variance Table of type III with Kenward-Roger
## approximation for degrees of freedom
##           Sum Sq Mean Sq NumDF  DenDF F.value    Pr(>F)
## Fert         0.36273 0.18136      2  91.075   3.4571 0.035717 *
## R_Year        0.43785 0.43785      1  42.786   8.3460 0.006044 **
## Fert:R_Year  0.36429 0.18214      2  91.078   3.4719 0.035227 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

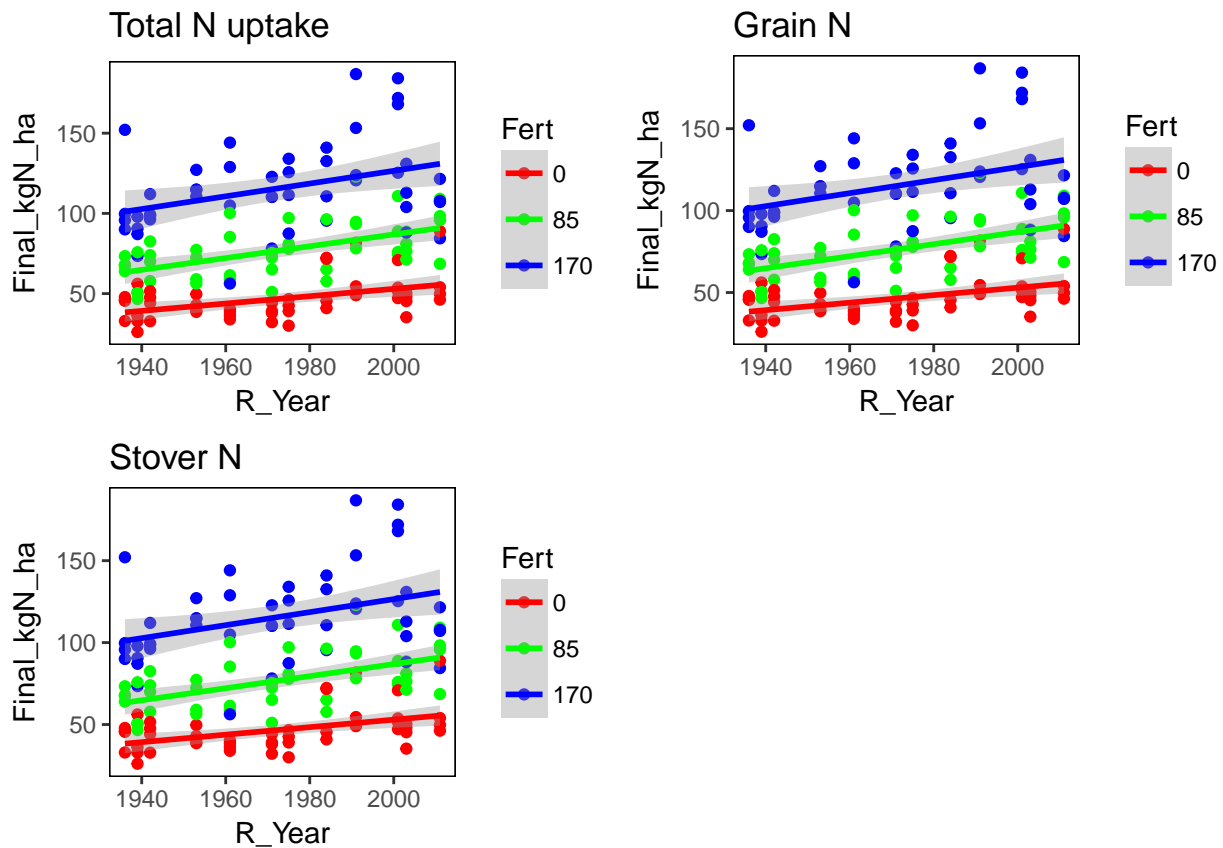
Total N in grain

```
## lme4::lmer(formula = log(Grain_kgN_ha) ~ Fert + R_Year + (1 |
##   Rep) + (1 | Rep:Row:Pos), data = sub, na.action = na.exclude)

## Analysis of Variance Table of type III with Kenward-Roger
```

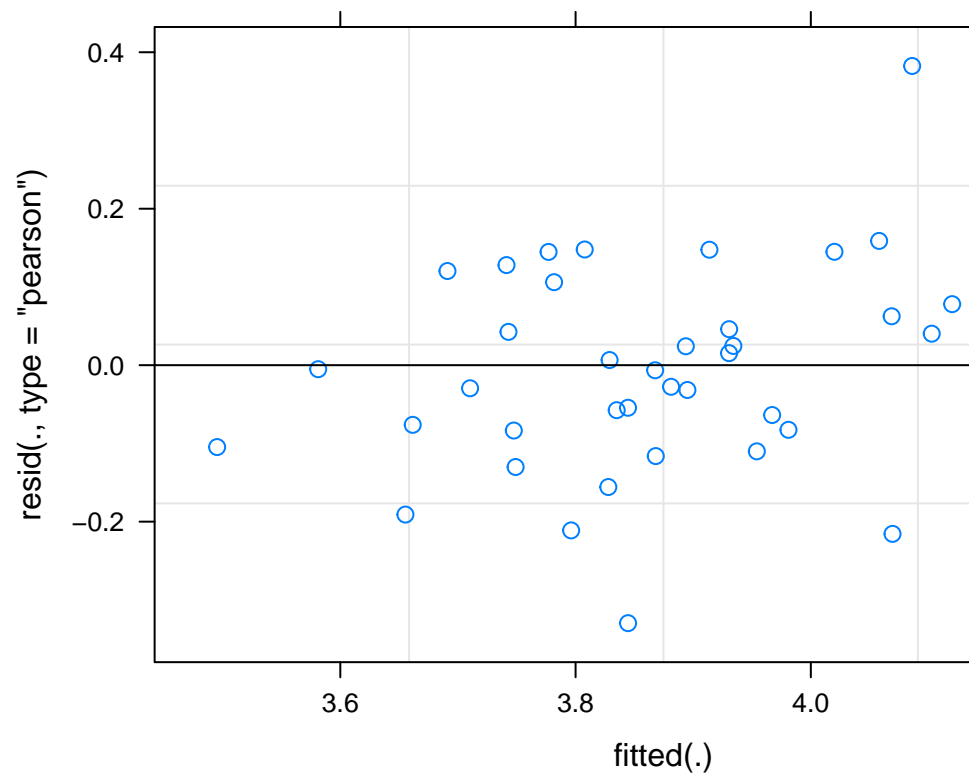
```
## approximation for degrees of freedom
##      Sum Sq Mean Sq NumDF  DenDF F.value    Pr(>F)
## Fert  29.7225 14.8612     2  93.331  318.78 < 2.2e-16 ***
## R_Year 1.0787  1.0787     1  42.736   23.14 1.902e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Plotting N uptake



Partitioning N from soil and fertilizer

Models



Total N uptake from soil in fertilized plots:

```
## lme4::lmer(formula = log(Total_kgSoilN_ha) ~ Fert + R_Year +  
## (1 | Rep) + (1 | Rep:Row:Pos), data = sub, na.action = na.exclude)  
  
## Analysis of Variance Table of type III with Kenward-Roger  
## approximation for degrees of freedom  
##      Sum Sq Mean Sq NumDF DenDF F.value    Pr(>F)  
## Fert  0.08859 0.08859     1    23   3.256 0.0842731 .  
## R_Year 0.61108 0.61108     1    19  22.459 0.0001428 ***  
## ---  
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

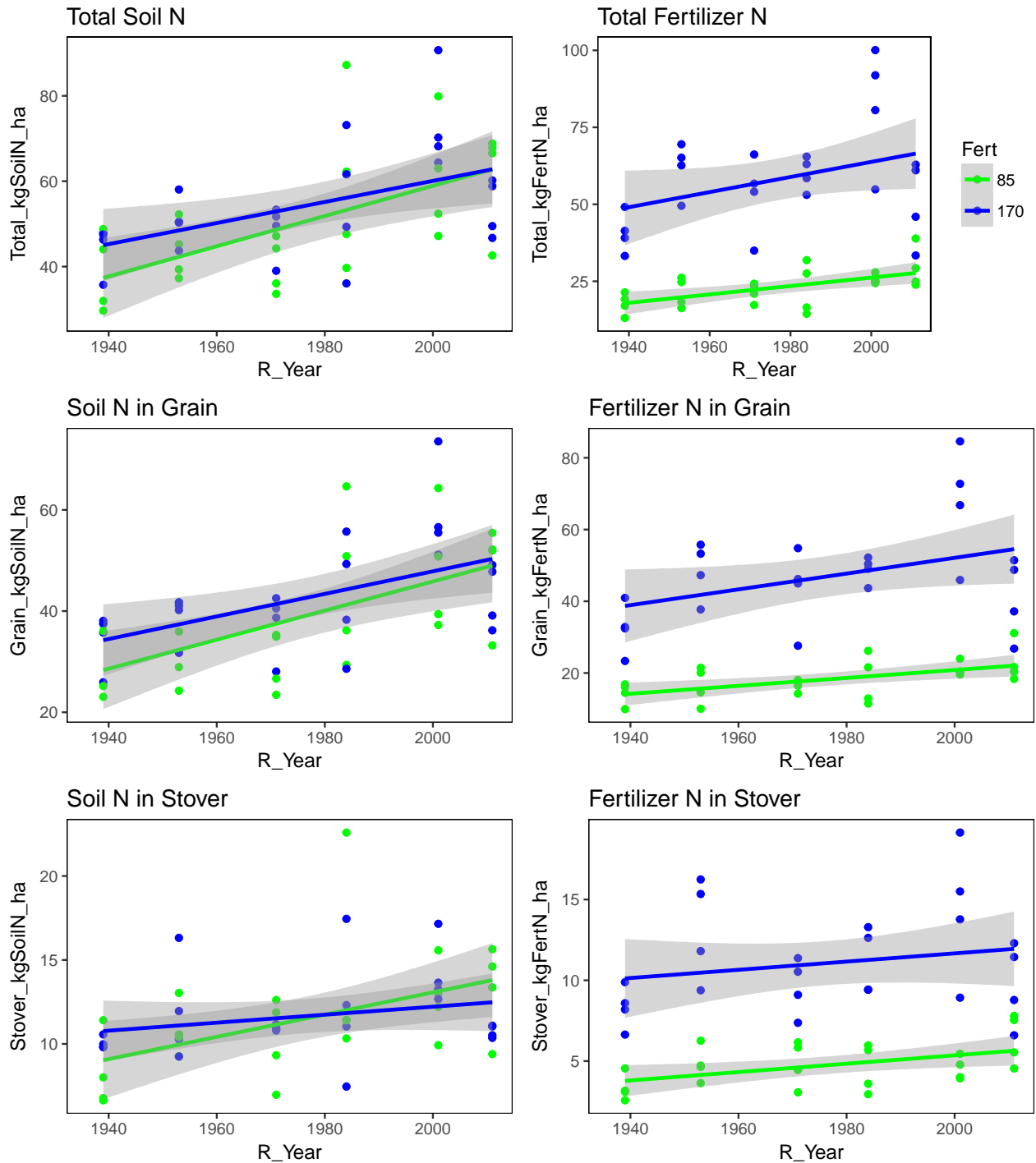
Plotting N partitioning

This is pretty cool, but I should run my calculations by you

```
grid.arrange(p1, p2,p3,p4, p5, p6,ncol = 2)
```

```
## Warning: Removed 48 rows containing non-finite values (stat_smooth).  
## Warning: Removed 48 rows containing missing values (geom_point).  
## Warning: Removed 48 rows containing non-finite values (stat_smooth).  
## Warning: Removed 48 rows containing missing values (geom_point).  
## Warning: Removed 48 rows containing non-finite values (stat_smooth).  
## Warning: Removed 48 rows containing missing values (geom_point).
```

```
## Warning: Removed 48 rows containing non-finite values (stat_smooth).
## Warning: Removed 48 rows containing missing values (geom_point).
## Warning: Removed 48 rows containing non-finite values (stat_smooth).
## Warning: Removed 48 rows containing missing values (geom_point).
## Warning: Removed 48 rows containing non-finite values (stat_smooth).
## Warning: Removed 48 rows containing missing values (geom_point).
```



Add a new chunk by clicking the *Insert Chunk* button on the toolbar or by pressing *Cmd+Option+I*.

When you save the notebook, an HTML file containing the code and output will be saved alongside it (click the *Preview* button or press *Cmd+Shift+K* to preview the HTML file).