Scott Farm Data

Simon Woodward

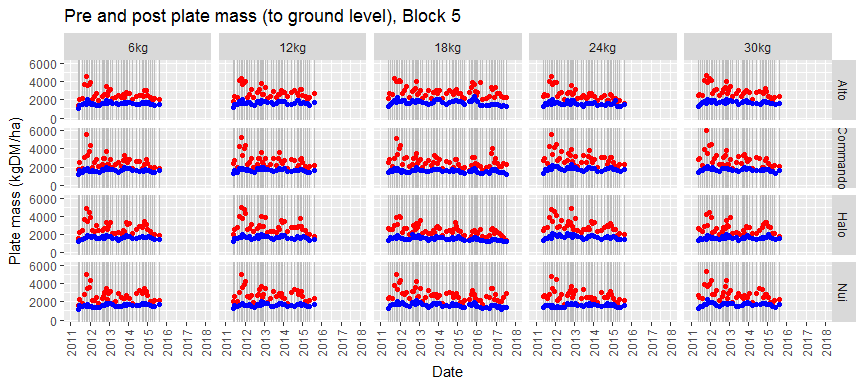
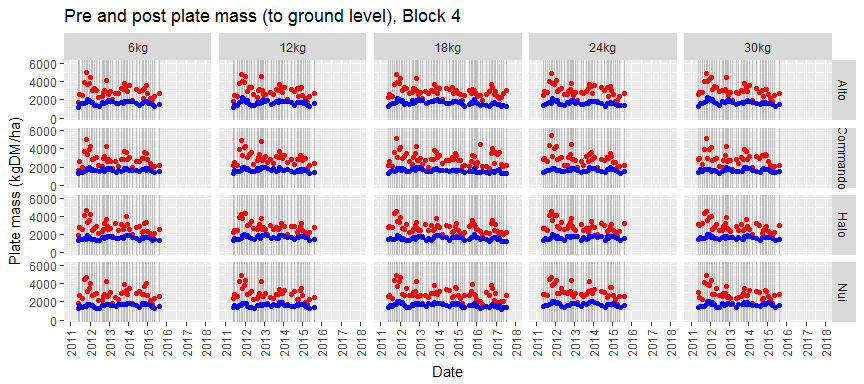
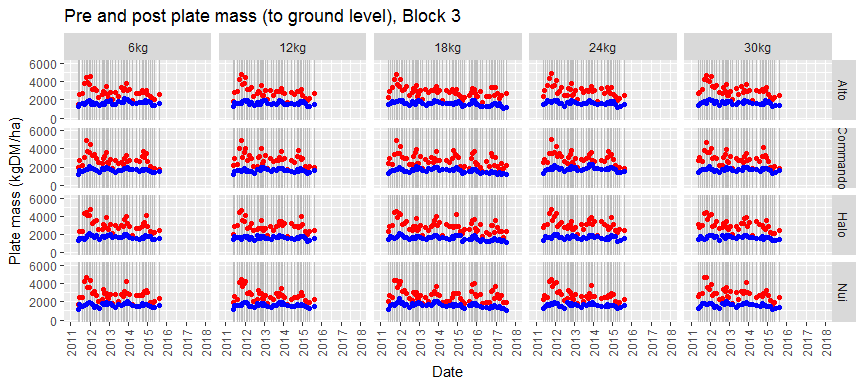
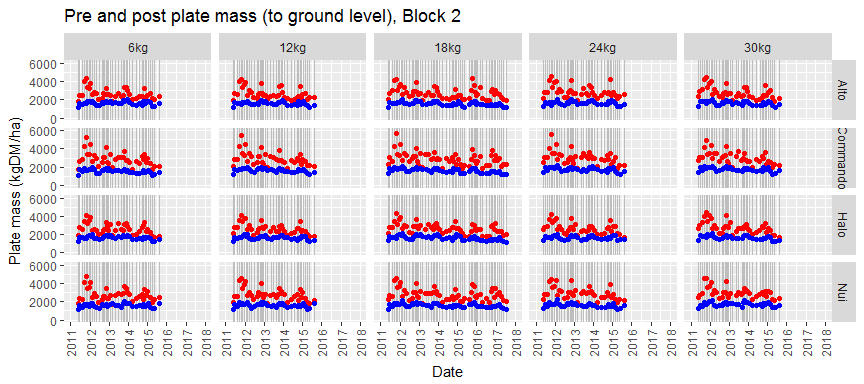
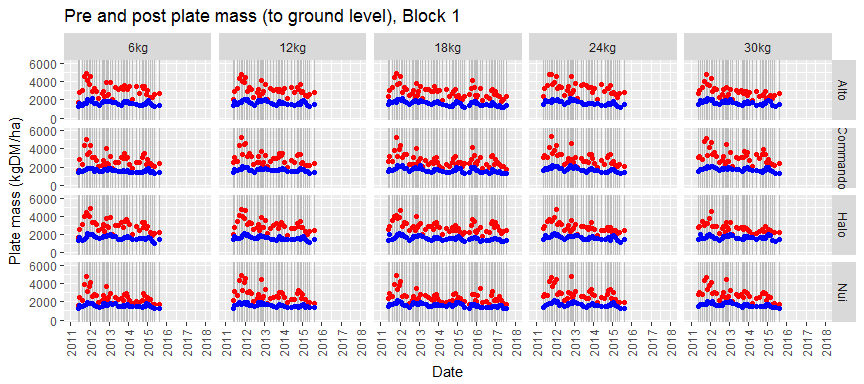
November 2, 2017

## Scott Farm Data

# file name  
file\_name <- 'FD1004 Data For Modelling.xlsx'  
  
# seed rates in order  
seed\_rate\_levels <- c('6kg', '12kg', '18kg', '24kg', '30kg')

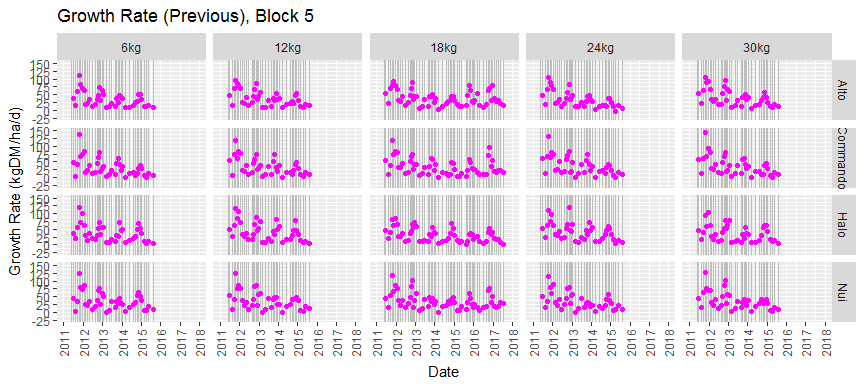
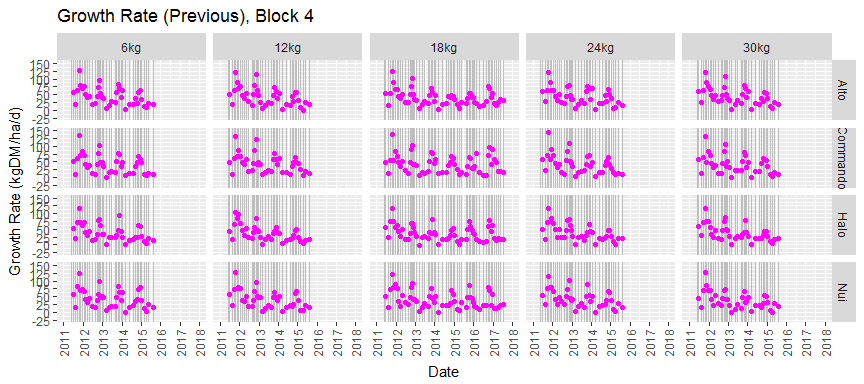
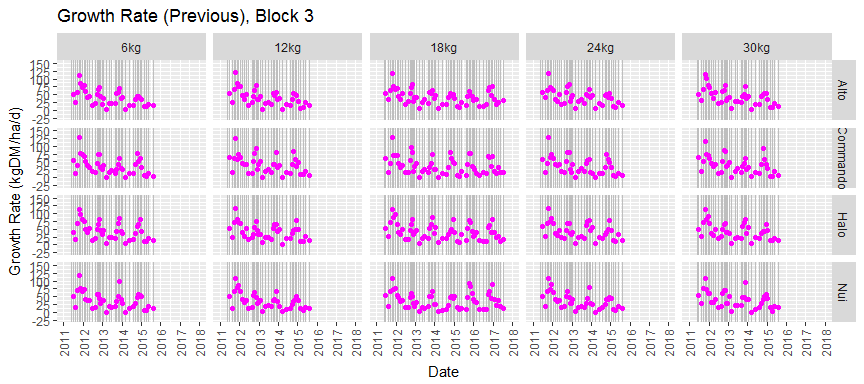
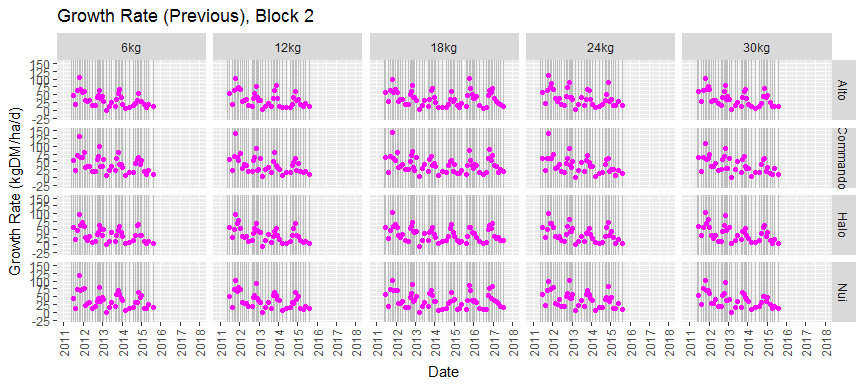
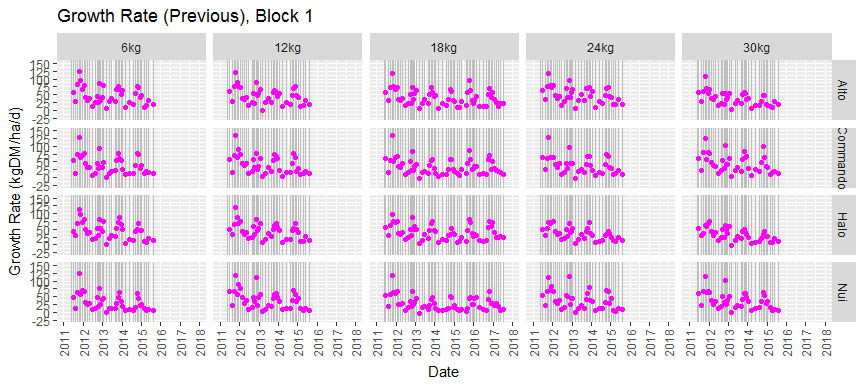
## Rising Plate Meter

# read and plot rpm data. There is some extra stuff in this sheet.  
data\_rpm <- read\_xlsx(file\_name, sheet='Waikato RPM Height data')  
names(data\_rpm) <- ensnakeify(names(data\_rpm))  
  
# rename useful variables  
data\_rpm <- data\_rpm %>%  
 mutate(seed\_rate = factor(seed\_rate, levels=seed\_rate\_levels)) %>%  
 rename(  
 date\_pre = date\_pre\_rpm\_d,  
 mass\_pre = pregrazing\_mass\_kg\_dm\_ha,  
 date\_post = date\_post\_rpm\_d,  
 mass\_post = postgrazing\_mass\_kg\_dm\_ha,  
 date\_grazed = date\_grazed\_d  
 ) %>%  
 select(date\_grazed, block, cultivar, seed\_rate, date\_pre, mass\_pre, date\_post, mass\_post)  
  
# plot pre and post mass by cultivar, seed\_rate and block  
ybreaks <- seq(0, round\_any(max(data\_rpm$mass\_pre, na.rm=TRUE), 2000, ceiling), 2000)  
xbreaks <- seq(floor\_date(min(data\_rpm$date\_pre), "years"),   
 ceiling\_date(max(data\_rpm$date\_post), "years"), by="1 year")  
data\_rpm %>%  
 split(.$block) %>%  
 map(~ggplot(.) +  
 labs(x='Date', y='Plate mass (kgDM/ha)',   
 title=paste('Pre and post plate mass (to ground level), Block', unique(.$block))) +  
 theme(axis.text.x=element\_text(angle=90, vjust=0.5, hjust=1)) +  
 geom\_vline(mapping=aes(xintercept=date\_grazed), colour='grey') +  
 geom\_point(mapping=aes(x=date\_pre, y=mass\_pre), colour='red') +  
 geom\_point(mapping=aes(x=date\_post, y=mass\_post), colour='blue') +  
 facet\_grid(cultivar ~ seed\_rate) +  
 scale\_x\_datetime(breaks=xbreaks, labels=year(xbreaks), limits=c(xbreaks[1], tail(xbreaks, 1))) +  
 scale\_y\_continuous(breaks=ybreaks, limits=c(ybreaks[1], tail(ybreaks, 1)))  
 )



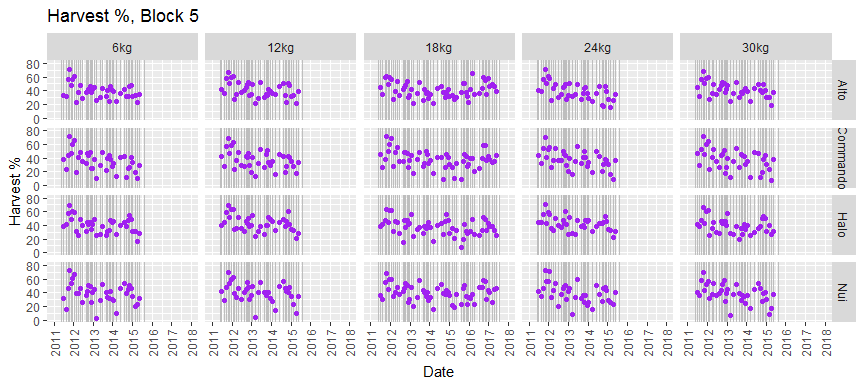
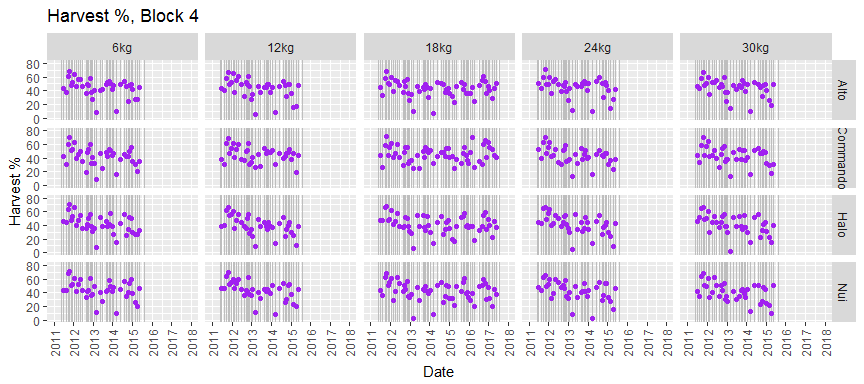
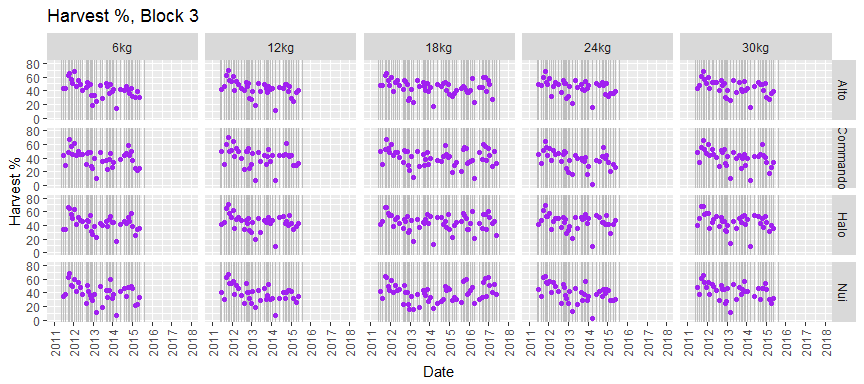
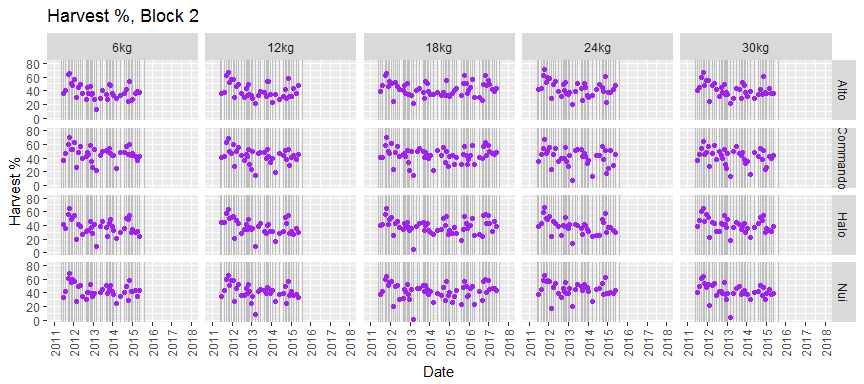
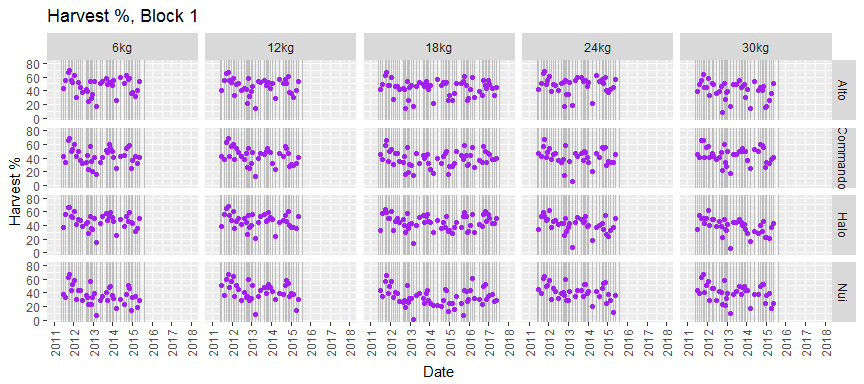
## Rising Plate Meter Growth Rate

# plot growth rate before grazing by cultivar, seed\_rate and block.  
# daily dry matter growth rate is assumed to be constant between grazings.  
data\_rpm <- data\_rpm %>%  
 group\_by(block, cultivar, seed\_rate) %>%  
 arrange(date\_grazed) %>%  
 mutate(  
 date\_post\_last = lag(date\_post ,1),  
 mass\_post\_last = lag(mass\_post ,1),  
 growth\_days\_pre = as.numeric(difftime(date\_pre, date\_post\_last), units="days"),  
 growth\_pre = mass\_pre - mass\_post\_last,  
 growth\_rate\_pre = growth\_pre / as.double(growth\_days\_pre),  
 growth\_rate\_post = lead(growth\_rate\_pre, 1),  
 )   
  
ybreaks <- seq(round\_any(min(data\_rpm$growth\_rate\_pre, na.rm=TRUE), 25, floor),   
 round\_any(max(data\_rpm$growth\_rate\_pre, na.rm=TRUE), 25, ceiling), 25)  
xbreaks <- seq(floor\_date(min(data\_rpm$date\_pre), "years"),   
 ceiling\_date(max(data\_rpm$date\_post), "years"), by="1 year")  
data\_rpm %>%  
 split(.$block) %>%  
 map(~ggplot(.) +  
 labs(x='Date', y='Growth Rate (kgDM/ha/d)',   
 title=paste('Growth Rate (Previous), Block', unique(.$block))) +  
 theme(axis.text.x=element\_text(angle=90, vjust=0.5, hjust=1)) +  
 geom\_vline(mapping=aes(xintercept=date\_grazed), colour='grey') +  
 geom\_point(mapping=aes(x=date\_grazed, y=growth\_rate\_pre), colour='magenta') +  
 facet\_grid(cultivar ~ seed\_rate) +  
 scale\_x\_datetime(breaks=xbreaks, labels=year(xbreaks), limits=c(xbreaks[1], tail(xbreaks, 1))) +  
 scale\_y\_continuous(breaks=ybreaks, limits=c(ybreaks[1], tail(ybreaks, 1)))  
 )



## Rising Plate Meter Harvest %

# plot harvest % by cultivar, seed\_rate and block.  
# grazing and residual mass are estimated by linear extrapolation of growth rate  
data\_rpm <- data\_rpm %>%  
 group\_by(block, cultivar, seed\_rate) %>%  
 mutate(  
 delay\_pre = as.numeric(difftime(date\_grazed, date\_pre), units="days"),  
 delay\_post = as.numeric(difftime(date\_post, date\_grazed), units="days"),  
 mass\_grazed = mass\_pre + growth\_rate\_pre \* delay\_pre,  
 mass\_resid = mass\_post - growth\_rate\_post \* delay\_post, # assumes growth starts immediately  
 harv = (1 - mass\_resid / mass\_grazed) \* 100 # proportion harvested  
 )  
  
ybreaks <- seq(0, round\_any(max(data\_rpm$harv, na.rm=TRUE), 20, ceiling), 20)  
xbreaks <- seq(floor\_date(min(data\_rpm$date\_pre), "years"),   
 ceiling\_date(max(data\_rpm$date\_post), "years"), by="1 year")  
data\_rpm %>%  
 split(.$block) %>%  
 map(~ggplot(.) +  
 labs(x='Date', y='Harvest %',   
 title=paste('Harvest %, Block', unique(.$block))) +  
 theme(axis.text.x=element\_text(angle=90, vjust=0.5, hjust=1)) +  
 geom\_vline(mapping=aes(xintercept=date\_grazed), colour='grey') +  
 geom\_point(mapping=aes(x=date\_grazed, y=harv), colour='purple') +  
 facet\_grid(cultivar ~ seed\_rate) +  
 scale\_x\_datetime(breaks=xbreaks, labels=year(xbreaks), limits=c(xbreaks[1], tail(xbreaks, 1))) +  
 scale\_y\_continuous(breaks=ybreaks, limits=c(ybreaks[1], tail(ybreaks, 1)))  
 )

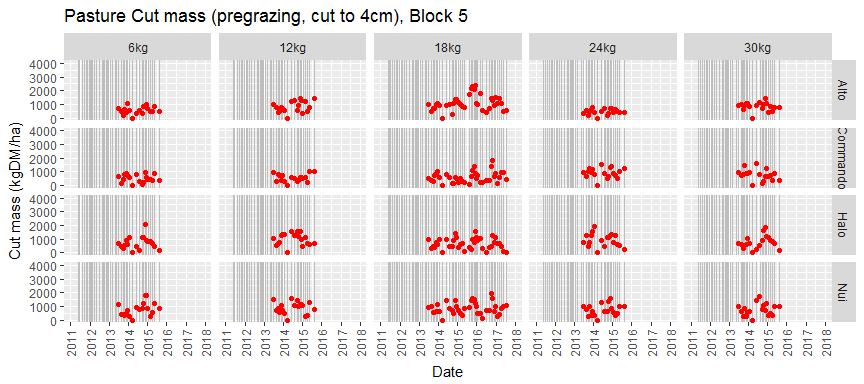
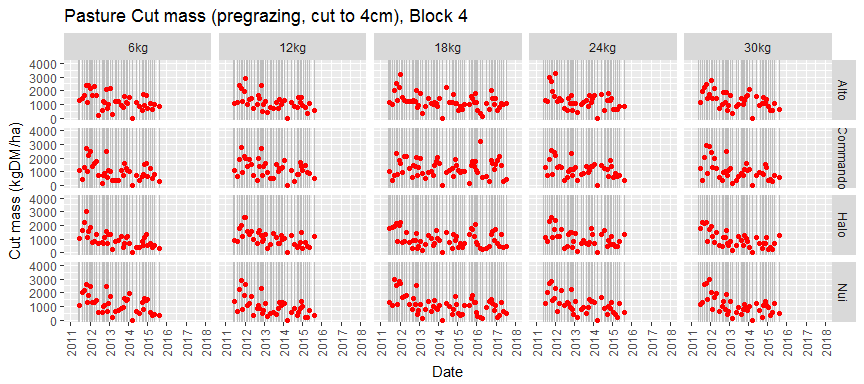
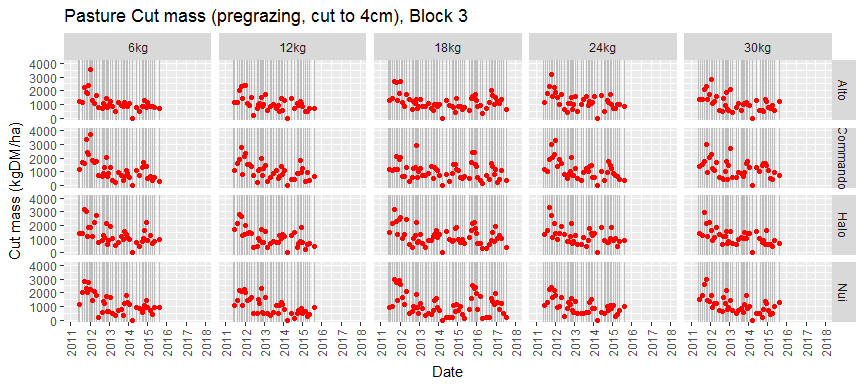
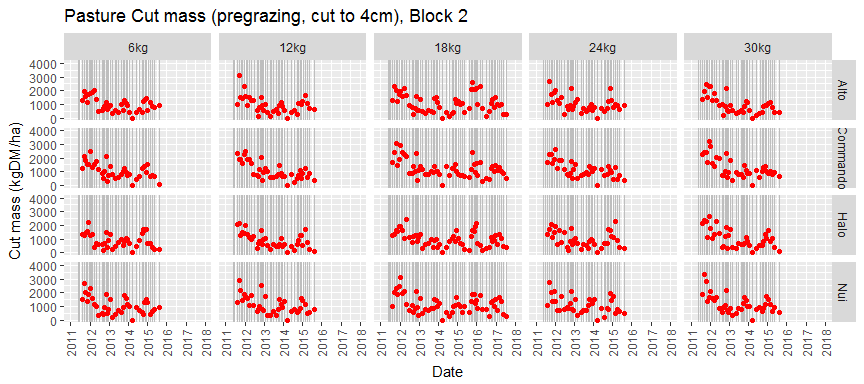
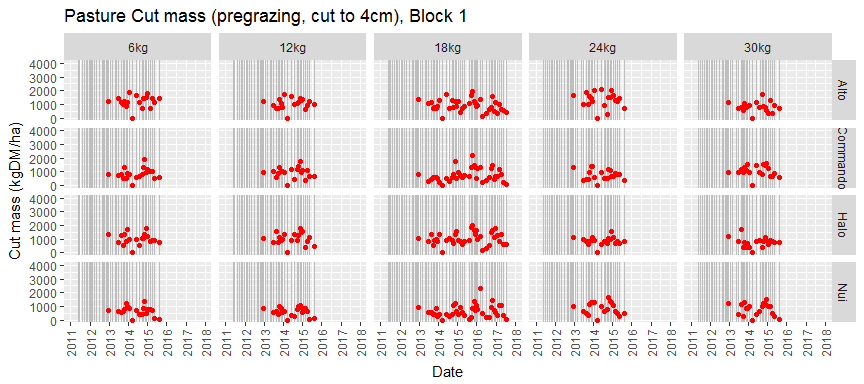


## Pasture Cut Mass

# read and plot cut mass data. Cuts were to 4-5 cm.  
data\_cut1 <- read\_xlsx(file\_name, sheet='Cut Yield Data Year1 2011to12')  
data\_cut2 <- read\_xlsx(file\_name, sheet='Cut Yield Data Year2 onwards')  
names(data\_cut1) <- ensnakeify(names(data\_cut1))  
names(data\_cut2) <- ensnakeify(names(data\_cut2))  
  
# rename useful variables  
data\_cut1 <- data\_cut1 %>%  
 mutate(seed\_rate = factor(seed\_rate, levels=seed\_rate\_levels)) %>%  
 rename(  
 date = date\_d,  
 yield = yield\_kg\_dm\_ha  
 ) %>%  
 mutate(  
 month = month(month)  
 ) %>%  
 group\_by(date, block, seed\_rate, cultivar) %>%  
 summarise(yield = mean(yield))  
  
# rename useful variables  
data\_cut2 <- data\_cut2 %>%  
 mutate(seed\_rate = factor(seed\_rate, levels=seed\_rate\_levels)) %>%  
 rename(  
 date = date\_d,  
 yield = yield\_kg\_dm\_ha,  
 dm\_pc = mean\_dm  
 ) %>%  
 mutate(  
 month = month(month)  
 ) %>%  
 select(date, block, seed\_rate, cultivar, yield, dm\_pc)  
  
# combine tables by row keeping common variables  
data\_cut <- full\_join(data\_cut1, data\_cut2)

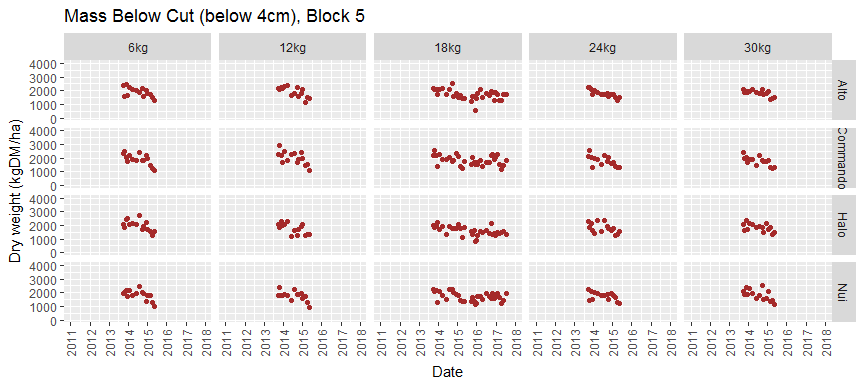
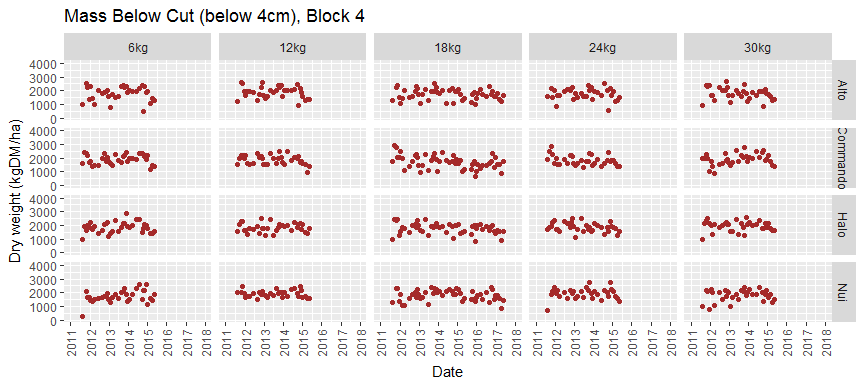
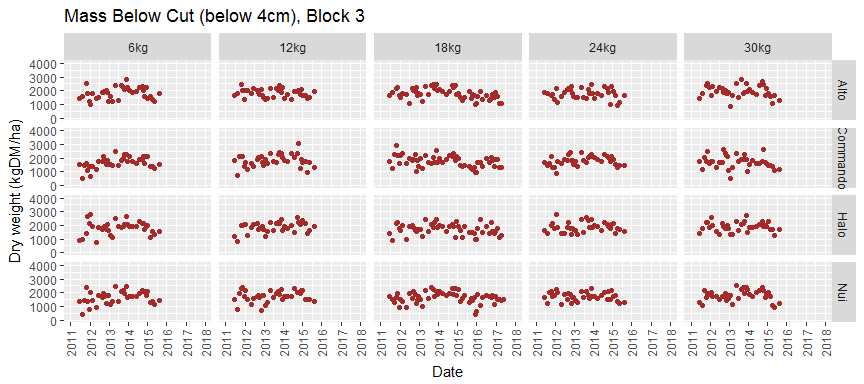
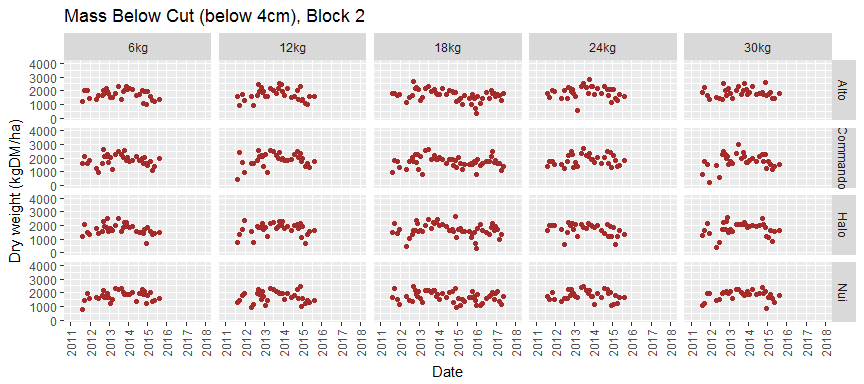
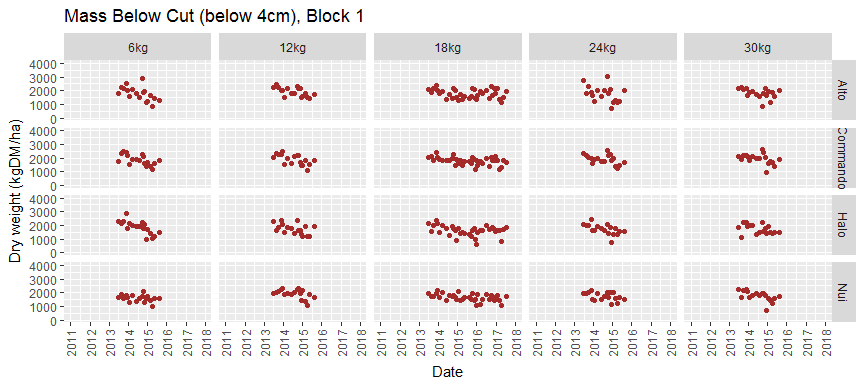
## Joining, by = c("date", "block", "seed\_rate", "cultivar", "yield")

# cutting dates for matching with other data sets  
date\_cut <- unique(data\_cut$date)  
closest\_date\_cut <- function(date){ # return index of closest date\_cut  
 i <- which(abs(date-date\_cut)==min(abs(date-date\_cut)))[[1]]  
}  
  
# plot yield data  
ybreaks <- seq(0, round\_any(max(data\_cut$yield, na.rm=TRUE), 1000, ceiling), 1000)  
xbreaks <- seq(floor\_date(min(data\_cut$date), "years"),   
 ceiling\_date(max(data\_cut$date), "years"), by="1 year")  
data\_cut %>%  
 split(.$block) %>%  
 map(~ggplot(.) +  
 labs(x='Date', y='Cut mass (kgDM/ha)',   
 title=paste('Pasture Cut mass (pregrazing, cut to 4cm), Block', unique(.$block))) +  
 theme(axis.text.x=element\_text(angle=90, vjust=0.5, hjust=1)) +  
 geom\_vline(data=data\_rpm, mapping=aes(xintercept=date\_grazed), colour='grey') +  
 geom\_point(mapping=aes(x=date, y=yield), colour='red') +  
 facet\_grid(cultivar ~ seed\_rate ) +  
 scale\_x\_datetime(breaks=xbreaks, labels=year(xbreaks), limits=c(xbreaks[1], tail(xbreaks, 1))) +  
 scale\_y\_continuous(breaks=ybreaks, limits=c(ybreaks[1], tail(ybreaks, 1)))  
 )



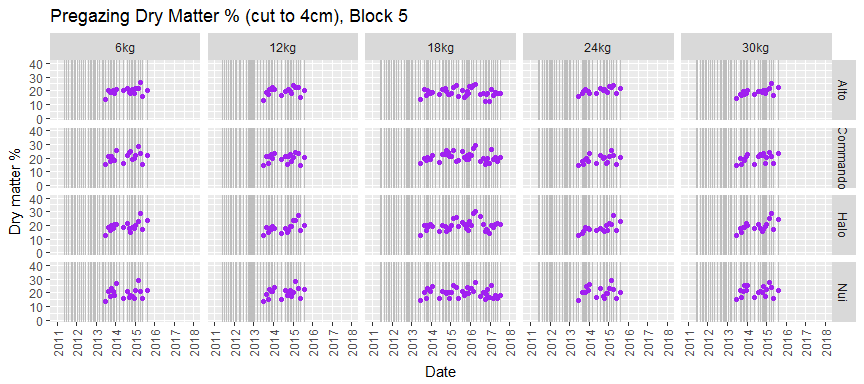
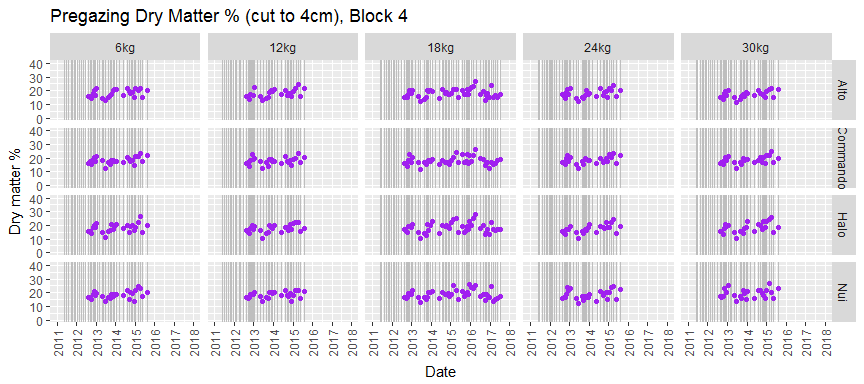
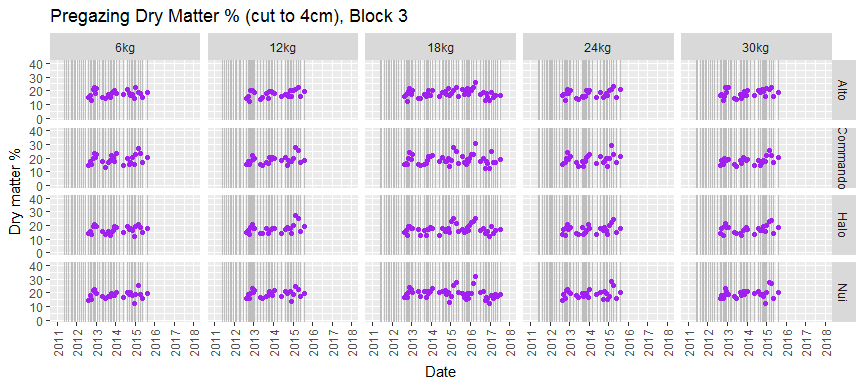
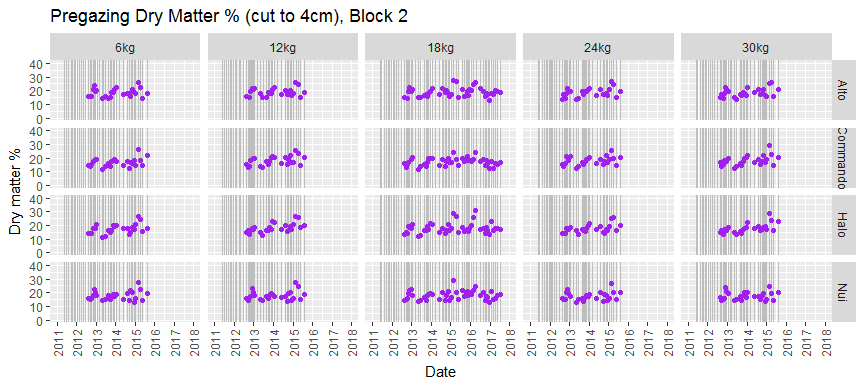
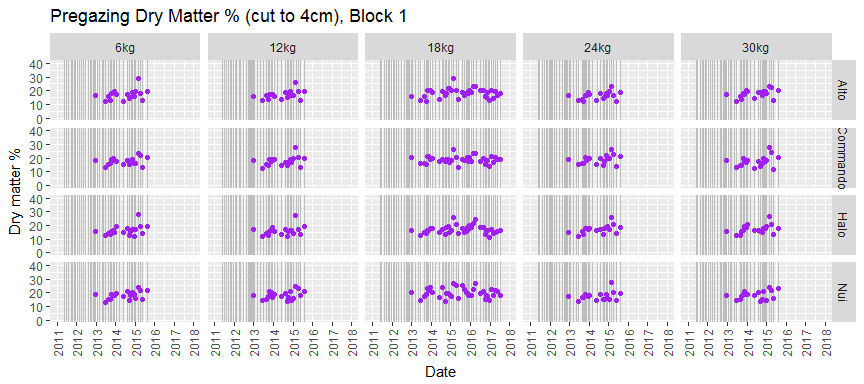
## Estimate Mass Below Cutting Height

# total mass at cutting is estimated by linear extrapolation of pregrazing rpm data  
# find cut matching rpm data  
data\_rpm$date\_cut\_i <- lapply(data\_rpm$date\_pre, closest\_date\_cut)  
data\_rpm$date\_cut <- date\_cut[unlist(data\_rpm$date\_cut\_i)]  
  
# join cut and rpm data by date\_cut and estimate mass on cutting date  
# mass below cutting height is this minus cut yield  
data\_cut$date\_cut <- data\_cut$date  
data\_bc <- data\_rpm %>%  
 left\_join(data\_cut, by=c('date\_cut', 'block', 'seed\_rate', 'cultivar')) %>%  
 select(date\_pre, date\_cut, block, seed\_rate, cultivar, mass\_pre, yield, growth\_rate\_pre) %>%  
 mutate(delay = as.integer(as.Date(date\_cut) - as.Date(date\_pre))) %>%   
 filter(abs(delay)<4) %>%  
 drop\_na() %>%  
 mutate(  
 mass\_cut = mass\_pre + growth\_rate\_pre \* delay,  
 below = mass\_cut - yield  
 )  
   
# copy below back into data\_cut  
data\_cut <- data\_cut %>%  
 left\_join(data\_bc, by=c('date\_cut', 'block', 'seed\_rate', 'cultivar')) %>%  
 select(date, block, seed\_rate, cultivar, yield.x, dm\_pc, date\_cut,   
 date\_pre, mass\_pre, delay, below, growth\_rate\_pre) %>%  
 rename(yield=yield.x)  
   
# plot below cutting mass  
ybreaks <- seq(0, round\_any(max(data\_bc$below, na.rm=TRUE), 1000, ceiling), 1000)  
xbreaks <- seq(floor\_date(min(data\_bc$date\_pre), "years"),   
 ceiling\_date(max(data\_bc$date\_pre), "years"), by="1 year")  
data\_bc %>%  
 split(.$block) %>%  
 map(~ggplot(.) +  
 labs(x='Date', y='Dry weight (kgDM/ha)', fill='Species',  
 title=paste('Mass Below Cut (below 4cm), Block', unique(.$block))) +  
 theme(axis.text.x=element\_text(angle=90, vjust=0.5, hjust=1)) +  
 geom\_point(mapping=aes(x=date\_pre, y=below), colour='brown') +  
 facet\_grid(cultivar ~ seed\_rate ) +  
 scale\_x\_datetime(breaks=xbreaks, labels=year(xbreaks), limits=c(xbreaks[1], tail(xbreaks, 1))) +  
 scale\_y\_continuous(breaks=ybreaks, limits=c(ybreaks[1], tail(ybreaks, 1)))  
 )



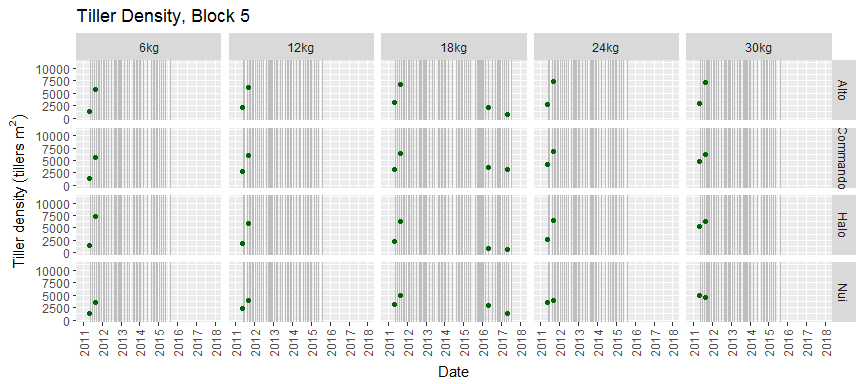
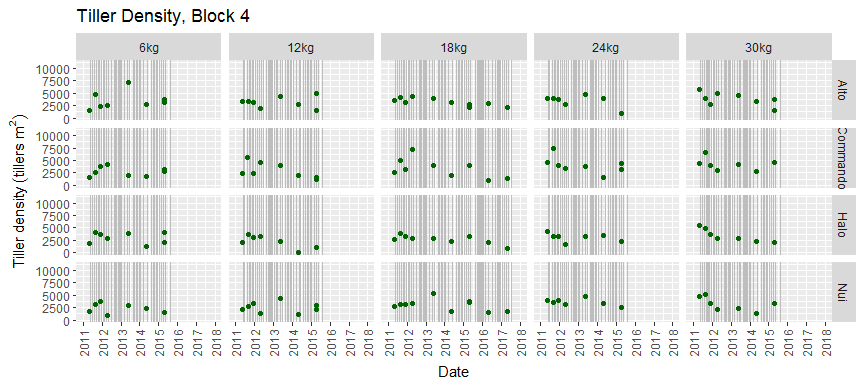
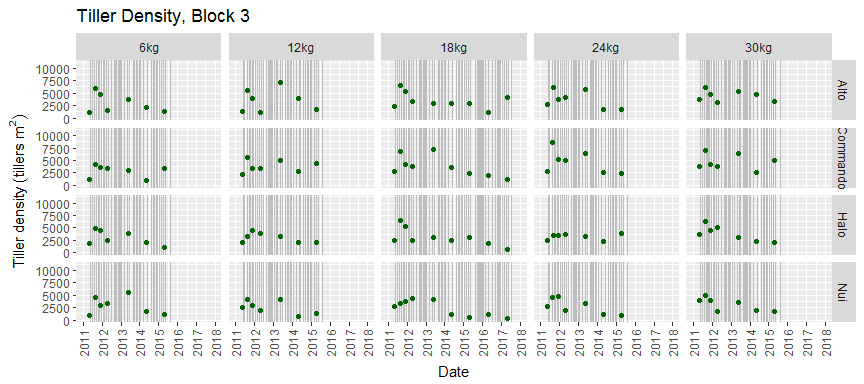
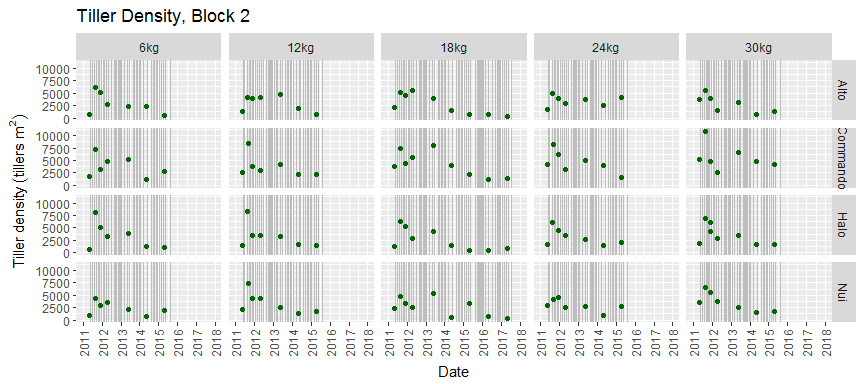
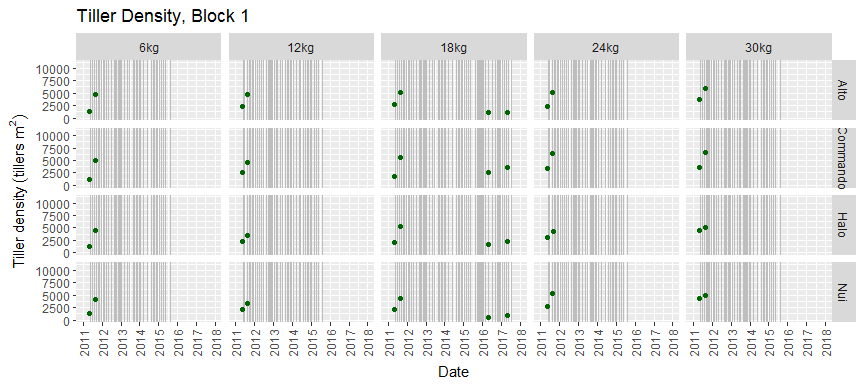
## Pasture Cuts DM%

# plot DM% data  
ybreaks <- seq(0, round\_any(max(data\_cut$dm\_pc, na.rm=TRUE), 10, ceiling), 10)  
xbreaks <- seq(floor\_date(min(data\_cut$date), "years"),   
 ceiling\_date(max(data\_cut$date), "years"), by="1 year")  
data\_cut %>%  
 split(.$block) %>%  
 map(~ggplot(.) +  
 labs(x='Date', y='Dry matter %',   
 title=paste('Pregazing Dry Matter % (cut to 4cm), Block', unique(.$block))) +  
 theme(axis.text.x=element\_text(angle=90, vjust=0.5, hjust=1)) +  
 geom\_vline(data=data\_rpm, mapping=aes(xintercept=date\_grazed), colour='grey') +  
 geom\_point(mapping=aes(x=date, y=dm\_pc), colour='purple') +  
 facet\_grid(cultivar ~ seed\_rate ) +  
 scale\_x\_datetime(breaks=xbreaks, labels=year(xbreaks), limits=c(xbreaks[1], tail(xbreaks, 1))) +  
 scale\_y\_continuous(breaks=ybreaks, limits=c(ybreaks[1], tail(ybreaks, 1)))  
 )



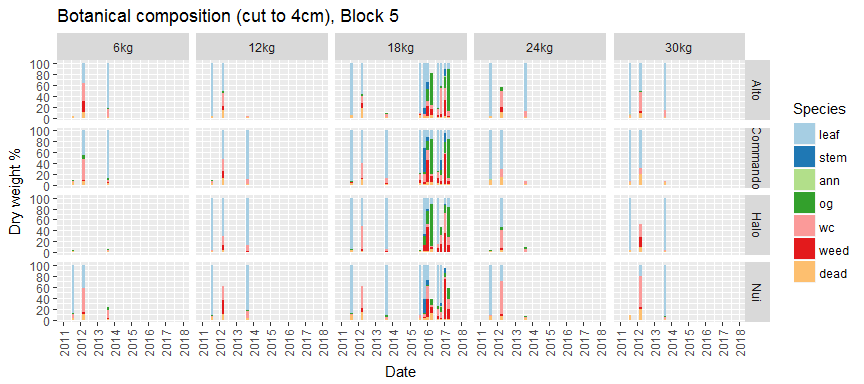
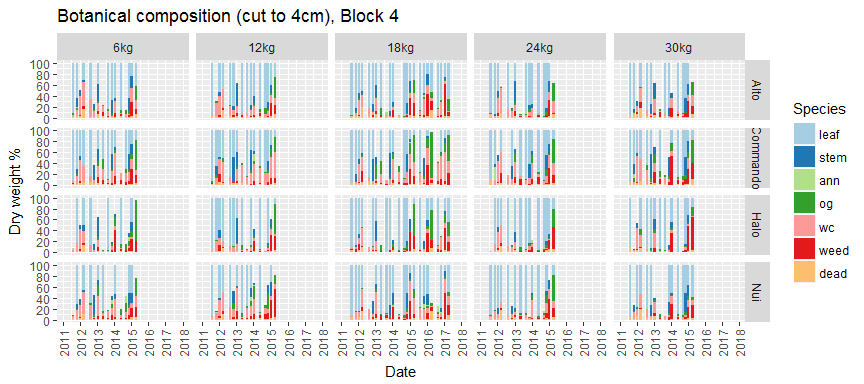
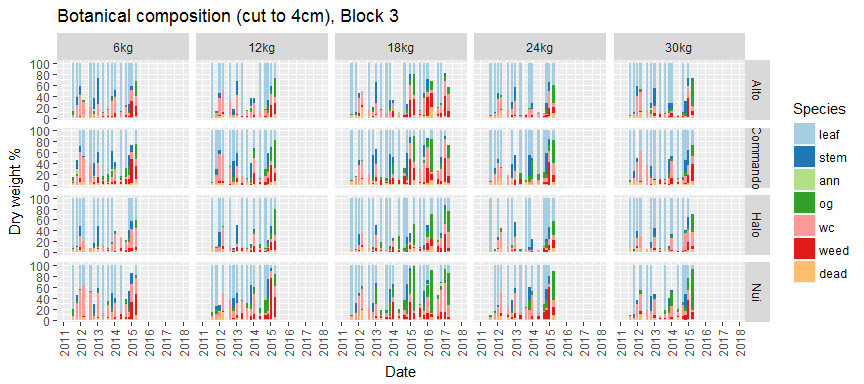
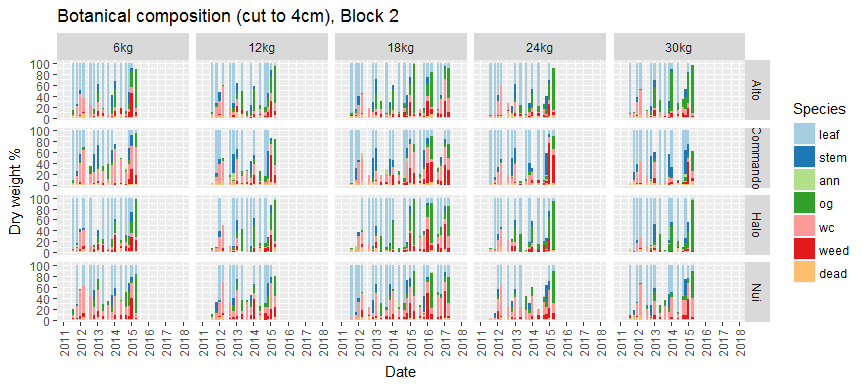
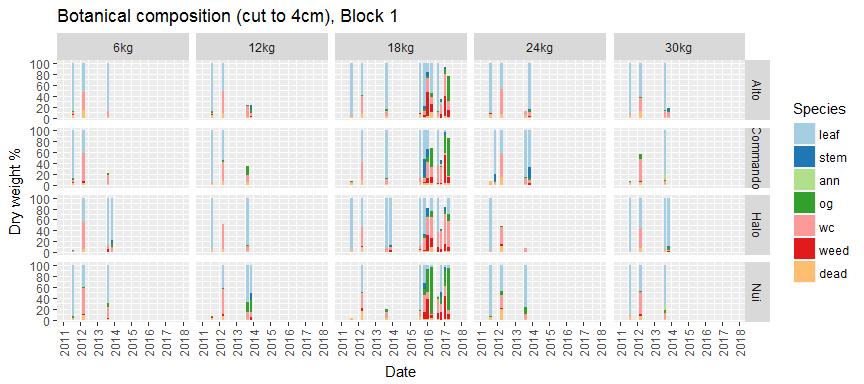
## Tiller Density

# read and plot tiller data  
data\_till <- read\_xlsx(file\_name, sheet='Tiller density data Waikato')  
names(data\_till) <- ensnakeify(names(data\_till))  
  
# rename useful variables  
data\_till <- data\_till %>%  
 mutate(seed\_rate = factor(seed\_rate, levels=seed\_rate\_levels)) %>%  
 rename(  
 date = date\_d,  
 tillers = ryegrass\_tiller\_density\_tillers\_m2  
 ) %>%  
 group\_by(block, cultivar, seed\_rate, date) %>%  
 summarise(mean\_tillers = mean(tillers))  
  
# plot tiller data ~(mg~L^{-1})  
ybreaks <- seq(0, round\_any(max(data\_till$mean\_tillers, na.rm=TRUE), 2500, ceiling), 2500)  
xbreaks <- seq(floor\_date(min(data\_till$date), "years"),   
 ceiling\_date(max(data\_till$date), "years"), by="1 year")  
data\_till %>%  
 split(.$block) %>%  
 map(~ggplot(.) +  
 labs(x='Date', y='Tiller density'~(tillers~m^{2}),   
 title=paste('Tiller Density, Block', unique(.$block))) +  
 theme(axis.text.x=element\_text(angle=90, vjust=0.5, hjust=1)) +  
 geom\_vline(data=data\_rpm, mapping=aes(xintercept=date\_grazed), colour='grey') +  
 geom\_point(mapping=aes(x=date, y=mean\_tillers), colour='darkgreen') +  
 facet\_grid(cultivar ~ seed\_rate ) +  
 scale\_x\_datetime(breaks=xbreaks, labels=year(xbreaks), limits=c(xbreaks[1], tail(xbreaks, 1))) +  
 scale\_y\_continuous(breaks=ybreaks,   
 limits=c(ybreaks[1], round\_any(max(data\_till$mean\_tillers, na.rm=TRUE), 1000, ceiling)))  
 )



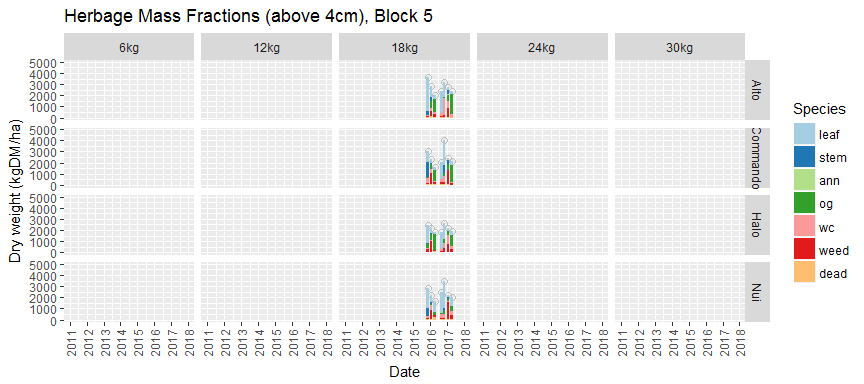
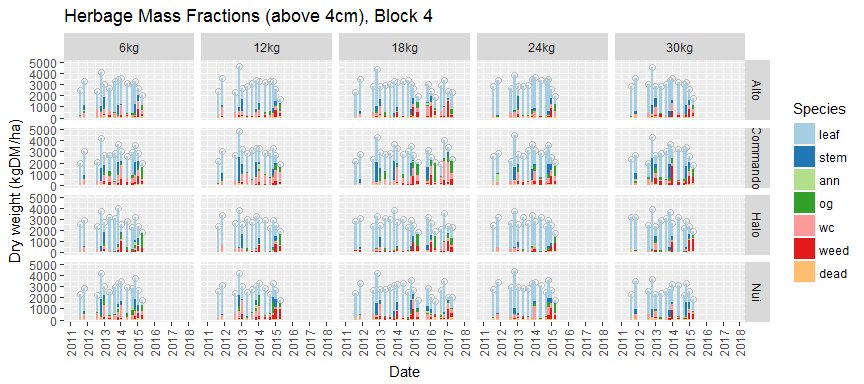
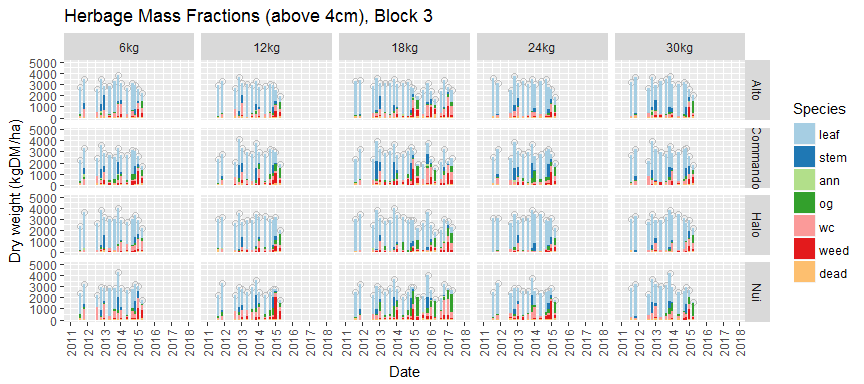
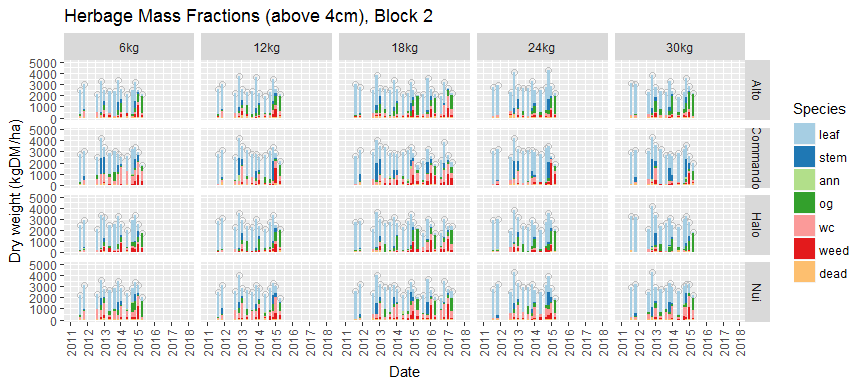
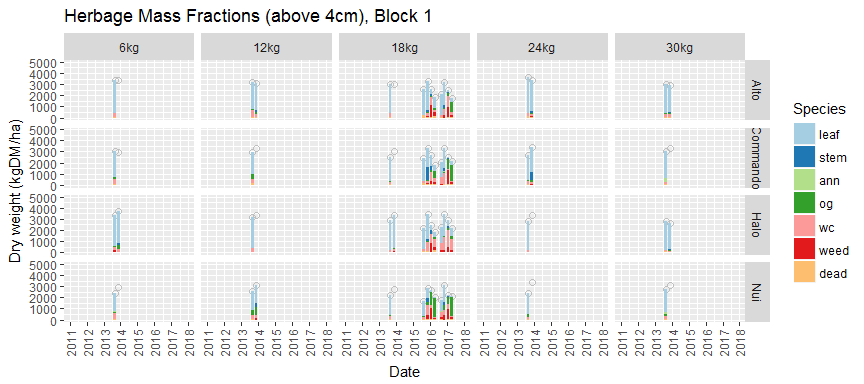
## Botanical Composition

# read botanical data. Skip blank line at top  
data\_bot <- read\_xlsx(file\_name, sheet='Botanical Composition data ', skip=1)  
names(data\_bot) <- ensnakeify(names(data\_bot))  
  
# rename useful variables  
data\_bot <- data\_bot %>%  
 mutate(seed\_rate = factor(seed\_rate, levels=seed\_rate\_levels)) %>%  
 rename(  
 date = date\_d,  
 leaf = perennial\_ryegrass\_leaf,  
 stem = perennial\_ryegrass\_reproductive\_stem,  
 ann = annual\_ryegrass,  
 wc = white\_clover,  
 poa = poa\_sp,  
 ogx = other\_grasses\_excluding\_poa,  
 og = other\_grasses\_including\_poa,  
 weed = weeds,  
 dead = dead  
 ) %>%  
 mutate(  
 total = leaf + stem + ann + wc + og + weed + dead, # should always be 100  
 month = month(dmy(paste('01', month, '2011')))  
 ) %>%  
 select(leaf, stem, ann, wc, og, weed, dead, date, total, block, seed\_rate, cultivar)   
   
# gather  
data\_bot2 <- data\_bot %>%  
 gather(leaf, stem, ann, wc, og, weed, dead, key='species', value='fraction') %>%  
 mutate(species = factor(species,   
 levels=c('leaf', 'stem', 'ann', 'og', 'wc', 'weed', 'dead')))  
  
# plot botanical data  
ybreaks <- seq(0, 100, 20)  
xbreaks <- seq(floor\_date(min(data\_bot2$date), "years"),   
 ceiling\_date(max(data\_bot2$date), "years"), by="1 year")  
data\_bot2 %>%  
 split(.$block) %>%  
 map(~ggplot(.) +  
 labs(x='Date', y='Dry weight %', fill='Species',  
 title=paste('Botanical composition (cut to 4cm), Block', unique(.$block))) +  
 theme(axis.text.x=element\_text(angle=90, vjust=0.5, hjust=1)) +  
 geom\_bar(mapping=aes(x=date, y=fraction, fill=species), stat='identity') +  
 scale\_fill\_brewer(palette='Paired') +  
 facet\_grid(cultivar ~ seed\_rate ) +  
 scale\_x\_datetime(breaks=xbreaks, labels=year(xbreaks), limits=c(xbreaks[1], tail(xbreaks, 1))) +  
 scale\_y\_continuous(breaks=ybreaks, limits=c(ybreaks[1], tail(ybreaks, 1)))  
 )



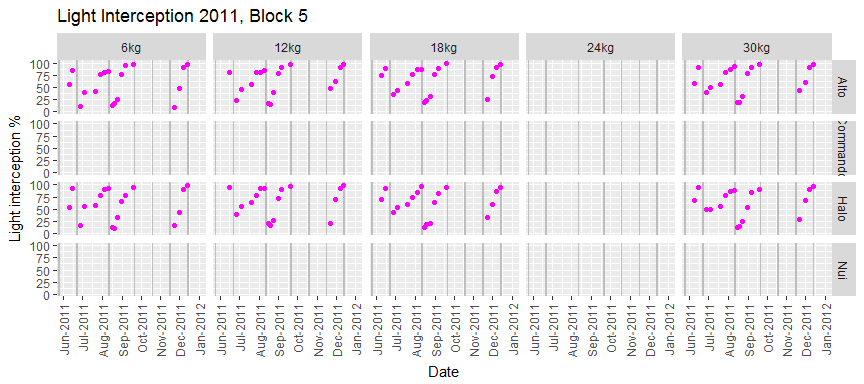
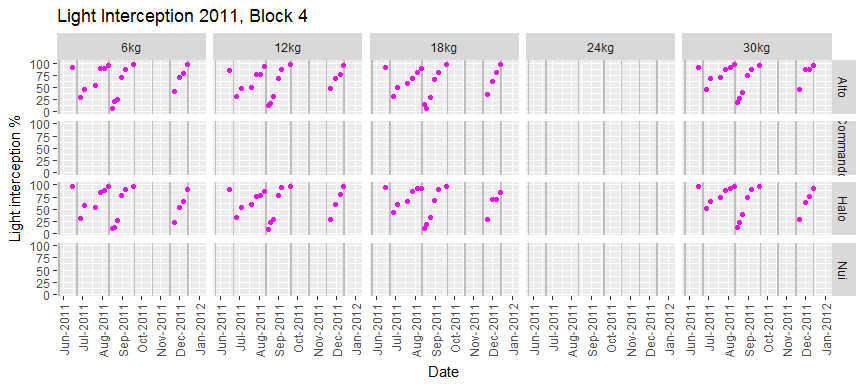
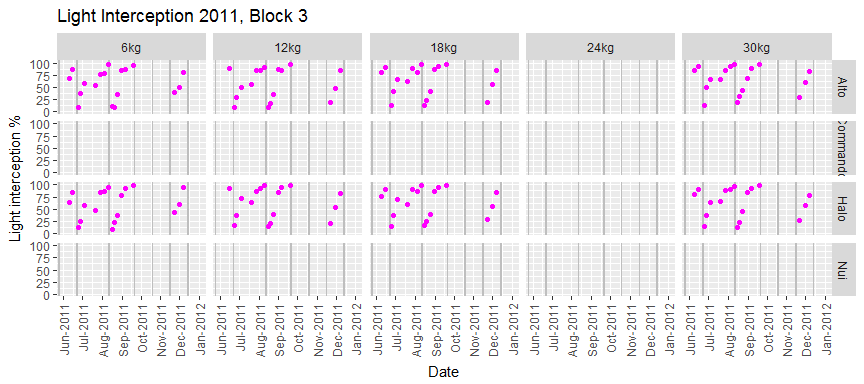
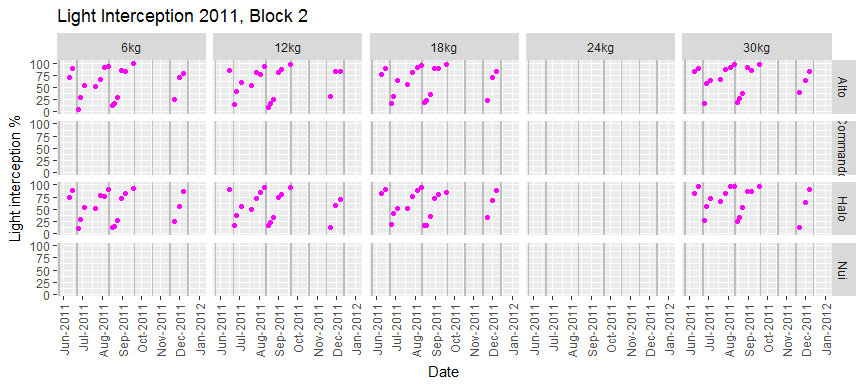
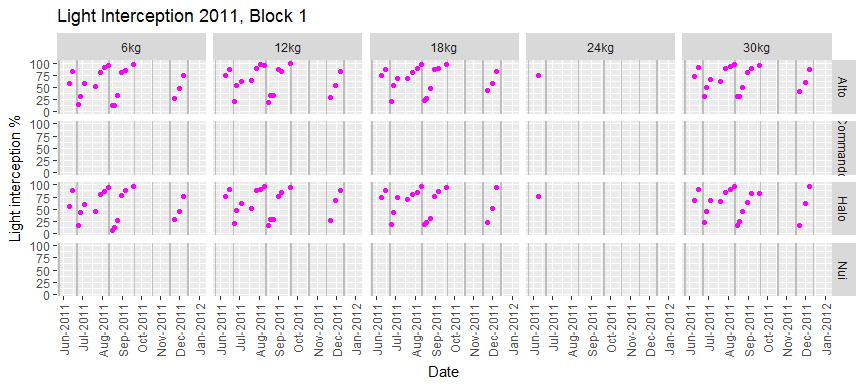
## Estimate Botancial Mass

# total mass on botanical date is estimate by linear extrapolation of rpm data  
# it's not clear how best to extrapolate botanical % above 4 cm to botancial mass above ground  
# find cut matching botanical data  
data\_bot$date\_cut\_i <- lapply(data\_bot$date, closest\_date\_cut)  
data\_bot$date\_cut <- date\_cut[unlist(data\_bot$date\_cut\_i)]  
  
# join cut and botanical data by date\_cut  
data\_cut$date\_cut <- data\_cut$date  
data\_bm <- data\_bot %>%  
 rename(date\_bot = date) %>%  
 left\_join(data\_cut, by=c('date\_cut', 'block', 'seed\_rate', 'cultivar')) %>%  
 select(date\_bot, date\_cut, block, seed\_rate, cultivar, leaf, stem, ann, wc, og, weed, dead,   
 yield, below, growth\_rate\_pre) %>%  
 rename(yield\_cut = yield) %>%  
 mutate(  
 delay = as.integer(as.Date(date\_bot) - as.Date(date\_cut)),  
 yield\_bot = yield\_cut + below + growth\_rate\_pre \* delay # assumed on date\_bot, including below mass?  
 )  
   
# gather  
data\_bm2 <- data\_bm %>%  
 gather(leaf, stem, ann, wc, og, weed, dead, key='species', value='fraction') %>%  
 mutate(  
 species = factor(species, levels=c('leaf', 'stem', 'ann', 'og', 'wc', 'weed', 'dead')),  
 species\_mass = fraction / 100 \* yield\_bot # include mass below cutting?  
 )   
  
# plot botanical data  
ybreaks <- seq(0, round\_any(max(data\_bm2$yield\_bot, na.rm=TRUE), 1000, ceiling), 1000)  
xbreaks <- seq(floor\_date(min(data\_bm2$date\_cut), "years"),   
 ceiling\_date(max(data\_bm2$date\_cut), "years"), by="1 year")  
data\_bm2 %>%  
 split(.$block) %>%  
 map(~ggplot(.) +  
 labs(x='Date', y='Dry weight (kgDM/ha)', fill='Species',  
 title=paste('Herbage Mass Fractions (above 4cm), Block', unique(.$block))) +  
 theme(axis.text.x=element\_text(angle=90, vjust=0.5, hjust=1)) +  
 geom\_point(mapping=aes(x=date\_cut, y=yield\_bot), colour='grey', size=2, shape=1) +  
 geom\_bar(mapping=aes(x=date\_cut, y=species\_mass, fill=species), stat='identity') +  
 scale\_fill\_brewer(palette='Paired') +  
 facet\_grid(cultivar ~ seed\_rate ) +  
 scale\_x\_datetime(breaks=xbreaks, labels=year(xbreaks), limits=c(xbreaks[1], tail(xbreaks, 1))) +  
 scale\_y\_continuous(breaks=ybreaks, limits=c(ybreaks[1],   
 round\_any(max(data\_bm2$yield\_bot, na.rm=TRUE), 100, ceiling)))  
 )



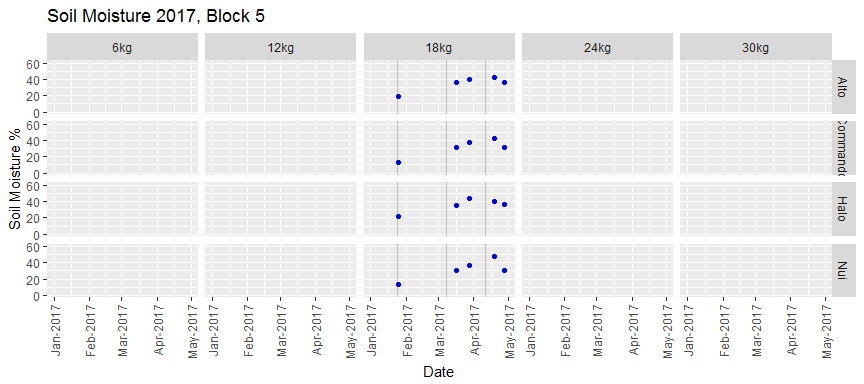
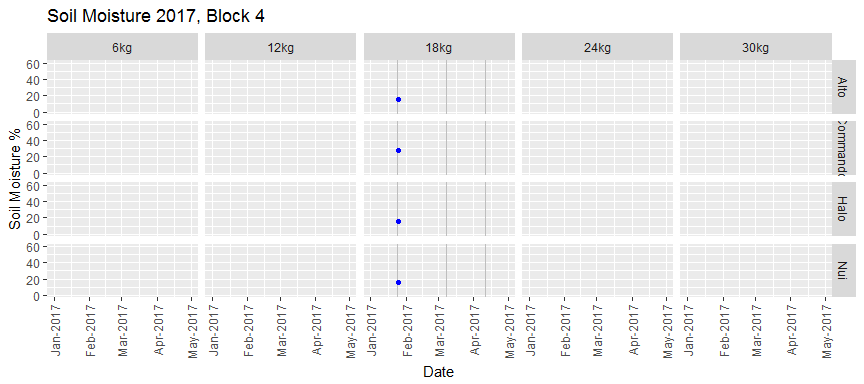
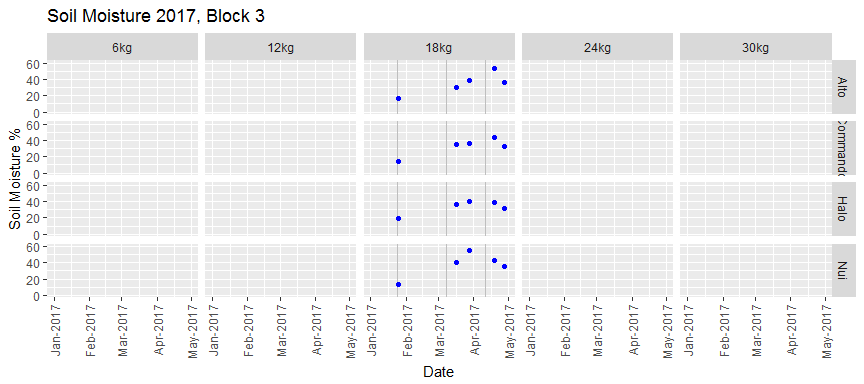
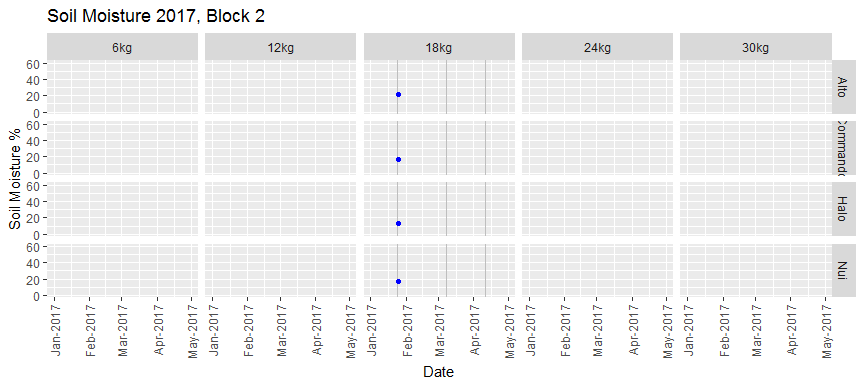
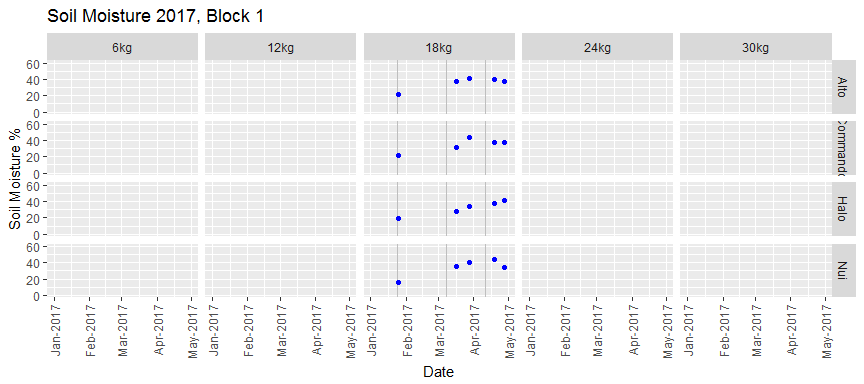
## Light Interception

# read and plot li data  
data\_li <- read\_xlsx(file\_name, sheet='Waikato LightInterception')  
names(data\_li) <- ensnakeify(names(data\_li))  
  
# rename useful variables  
data\_li <- data\_li %>%  
 mutate(  
 block = floor((plot-1)/20)+1, # this needs to be checked   
 seed\_rate = factor(seed\_rate, levels=seed\_rate\_levels)  
 ) %>%  
 rename(  
 date = date,  
 date\_grazed = date\_last\_grazed,  
 li = light\_interception  
 ) %>%  
 select(date, block, seed\_rate, cultivar, li, date\_grazed)  
  
# plot light interception data  
ybreaks <- seq(0, round\_any(max(data\_li$li, na.rm=TRUE), 25, ceiling), 25)  
xbreaks <- seq(floor\_date(min(data\_li$date), "months"),   
 ceiling\_date(max(data\_li$date), "months"), by="1 month")  
data\_li %>%  
 split(.$block) %>%  
 map(~ggplot(.) +  
 labs(x='Date', y='Light interception %',   
 title=paste('Light Interception 2011, Block', unique(.$block))) +  
 theme(axis.text.x=element\_text(angle=90, vjust=0.5, hjust=1)) +  
 geom\_vline(data=data\_rpm, mapping=aes(xintercept=date\_grazed), colour='grey') +  
 geom\_point(mapping=aes(x=date, y=li), colour='magenta') +  
 facet\_grid(cultivar ~ seed\_rate ) +  
 scale\_x\_datetime(breaks=xbreaks, labels=format(xbreaks, "%b-%Y"), limits=c(xbreaks[1], tail(xbreaks, 1))) +  
 scale\_y\_continuous(breaks=ybreaks, limits=c(ybreaks[1], tail(ybreaks, 1)))  
  
 )



## Soil Moisture

# read and plot soil moisture data  
data\_sm <- read\_xlsx(file\_name, sheet='Soil moisture data')  
names(data\_sm) <- ensnakeify(names(data\_sm))  
  
# rename useful variables  
data\_sm <- data\_sm %>%  
 mutate(seed\_rate = factor(seed\_rate, levels=seed\_rate\_levels)) %>%  
 rename(  
 date = date\_measured\_d,  
 sm = soil\_moisture  
 ) %>%  
 group\_by(block, cultivar, seed\_rate, date) %>%  
 summarise(mean\_sm = mean(sm))  
  
# plot sol moisture data  
ybreaks <- seq(0, round\_any(max(data\_sm$mean\_sm, na.rm=TRUE), 20, ceiling), 20)  
xbreaks <- seq(floor\_date(min(data\_sm$date), "months"),   
 ceiling\_date(max(data\_sm$date), "months"), by="1 month")  
data\_sm %>%  
 split(.$block) %>%  
 map(~ggplot(.) +  
 labs(x='Date', y='Soil Moisture %',   
 title=paste('Soil Moisture 2017, Block', unique(.$block))) +  
 theme(axis.text.x=element\_text(angle=90, vjust=0.5, hjust=1)) +  
 geom\_vline(data=data\_rpm, mapping=aes(xintercept=date\_grazed), colour='grey') +  
 geom\_point(mapping=aes(x=date, y=mean\_sm), colour='blue') +  
 facet\_grid(cultivar ~ seed\_rate ) +  
 scale\_x\_datetime(breaks=xbreaks, labels=format(xbreaks, "%b-%Y"), limits=c(xbreaks[1], tail(xbreaks, 1))) +  
 scale\_y\_continuous(breaks=ybreaks, limits=c(ybreaks[1], tail(ybreaks, 1)))  
  
 )



## Calculations

# additional calculations to prepare data for model calibration  
# move post harvest measurements if on grazing day  
data\_rpm$date\_post2 <- as.Date(with(data\_rpm,  
 ifelse(date\_post > date\_grazed,   
 as.Date(date\_post),   
 as.Date(date\_post) + 1)  
 ), origin="1970-01-01")  
  
# some calculations  
data\_rpm <- data\_rpm %>%  
 mutate(  
 year\_pre = year(date\_pre),  
 doy\_pre = yday(date\_pre),  
 year\_post = year(date\_post2),  
 doy\_post = yday(date\_post2),  
 year\_grazed = year(date\_grazed),  
 doy\_grazed = yday(date\_grazed),   
 days\_pre = difftime(date\_grazed, date\_pre),  
 days\_post = difftime(date\_post2, date\_grazed)  
 )  
  
# choose data  
acultivar <- 'Alto' # only Alto and Halo have light interception data  
aseed\_rate <- '18kg'  
ablock <- 3

## Write Harvest Dates

# write harvest dates and harvest % for selected series  
data\_h <- data\_rpm %>%  
 select(block, seed\_rate, cultivar, year\_grazed, doy\_grazed, harv) %>%  
 filter(block==ablock & seed\_rate==aseed\_rate & cultivar==acultivar) %>%  
 drop\_na()  
days\_harvest <- matrix(as.integer(-1), nrow=100, ncol=3) # up to 100 harvests  
days\_harvest[1:nrow(data\_h),] <- c(data\_h$year\_grazed, data\_h$doy\_grazed, data\_h$harv)  
write.table(days\_harvest, file="harvest\_Scott.txt",   
 row.names=FALSE, col.names=FALSE, sep='\t')

## Write Calibration Data

# collect the data in this list  
data\_c <- vector("list", 6)   
  
# pre and post mass (but this includes other species!)  
temp <- data\_rpm %>%  
 select(block, seed\_rate, cultivar, mass\_pre, year\_pre, doy\_pre,   
 mass\_post, year\_post, doy\_post) %>%  
 filter(block==ablock & seed\_rate==aseed\_rate & cultivar==acultivar)   
# data\_c[[1]] <- with(temp, tibble(var='DM', year=year\_pre,   
# doy=doy\_pre, data=mass\_pre/10) %>% drop\_na())  
# data\_c[[2]] <- with(temp, tibble(var='DM', year=year\_post,   
# doy=doy\_post, data=mass\_post/10) %>% drop\_na())  
  
# ryegrass tillers  
temp <- data\_till %>%  
 select(block, seed\_rate, cultivar, mean\_tillers, date) %>%  
 filter(block==ablock & seed\_rate==aseed\_rate & cultivar==acultivar)   
data\_c[[3]] <- with(temp, tibble(var='TILTOT', year=year(date),   
 doy=yday(date), data=mean\_tillers) %>% drop\_na())  
  
# ryegrass fraction  
temp <- data\_bot %>%  
 select(block, seed\_rate, cultivar, leaf, stem, date) %>%  
 filter(block==ablock & seed\_rate==aseed\_rate & cultivar==acultivar)   
# data\_c[[4]] <- with(temp, tibble(var='CSTP', year=year(date),   
# doy=yday(date), data=stem/(leaf+stem)\*100) %>% drop\_na())  
  
# ryegrass mass (total or above cutting height? depending on definition of yield\_bot)  
temp <- data\_bm %>%  
 rename(date = date\_cut) %>%  
 select(block, seed\_rate, cultivar, leaf, stem, yield\_bot, date) %>%  
 filter(block==ablock & seed\_rate==aseed\_rate & cultivar==acultivar)   
data\_c[[4]] <- with(temp, tibble(var='CLV', year=year(date),   
 doy=yday(date), data=leaf/100\*yield\_bot/10) %>% drop\_na())  
data\_c[[5]] <- with(temp, tibble(var='CST', year=year(date),   
 doy=yday(date), data=stem/100\*yield\_bot/10) %>% drop\_na())  
  
# light interception (but this includes all species!)  
temp <- data\_li %>%  
 select(block, seed\_rate, cultivar, li, date) %>%  
 filter(block==ablock & seed\_rate==aseed\_rate & cultivar==acultivar)   
# data\_c[[5]] <- with(temp, tibble(var='LINT', year=year(date),   
# doy=yday(date), data=li) %>% drop\_na())  
  
# soil moisture  
temp <- data\_sm %>%  
 select(block, seed\_rate, cultivar, mean\_sm, date) %>%  
 filter(block==ablock & seed\_rate==aseed\_rate & cultivar==acultivar)   
data\_c[[6]] <- with(temp, tibble(var='WCL', year=year(date),   
 doy=yday(date), data=mean\_sm) %>% drop\_na())  
  
# bind list and write file  
data\_calib <- bind\_rows(data\_c)  
data\_calib <- arrange(data\_calib, var, year, doy)  
write.table(data\_calib, file="data\_calibration\_Scott.txt",   
 row.names=FALSE, col.names=FALSE, sep='\t', quote=FALSE)