Supplemental File 1: Scripts used for Analysis

#1.#Calculating BLUPS using Lmer function

#Calculating Blups using lmer function

## DF

# rep injection sample c1 c2 c3 ...

#for i in 1:ncol(DF){

#Import file, remember to use T and F

spec <- read.csv("C:/Users/Tiger/Desktop/Rworking/spec\_all\_withpheno.csv", header=T, sep=",", fill=F, dec=".")

head(spec)

tail(spec)

#Running BLUP calculations using lmer function

#install package needed for lme4

install.packages("lme4",

 repos= c("http://lme4.r-forge.r-project.org/repos",

 getOption("repos")[["CRAN"]]))

spec.model <- lmer(C2 ~ injection + rep + (1|Clone),

 data = spec, control = lmerControl(check.nlev.gtr.1 = "ignore"), na.action = na.omit)

 fixed.effects <- fixef(spec.model)

 blubs <- ranef(spec.model)

 print(blubs)

 write.csv(blubs,"C:/Users/Tiger/Desktop/Rworking/blubs\_test.csv")

 print(fixed.effects)

 summary(spec.model)

# Broad-sense heritability (H2)

varsummary <- as.numeric(VarCorr(spec.model), comp="Variance")

varSample = varsummary

varError <- attr(VarCorr(spec.model),"sc")^2

varResidual = varError

H2 <- (varSample)/(varSample + varResidual)

#2.#Calculating Principal Components

library(devtools)

find\_rtools()

install\_github("thibautjombart/adegenet")

library(adegenet)

library(GWASpoly)

#calculate PCA

data <- read.GWASpoly(ploidy = 4, pheno.file = "blups\_corey\_trans.csv",

 geno.file = "genetic\_data\_solcap.csv", format="ACGT", n.traits = 981, delim = ",")

datagen<-read.csv("genetic\_data\_solcap.csv", header=T)

datagen[1:5,1:5]

#calculate K matrix, if you have set parameters than use set.params function,

#i did not use param function in gwas function because I did not have fixed effects

data2 <- set.K(data)

data@geno[1:5,1:5]

#principal component

Mc<-scale(data2@geno)

svdMc<-svd(Mc)

#shows PCa loadings

PCsm<-Mc%\*%svdMc$v

pc1=data.frame (name=row.names(PCsm),pc1=PCsm[,1])

write.csv(pc1,"pc1.csv")

plot(PCsm[,1],PCsm[,2])

loadings1<-svdMc$v[,1:3]

rownames(loadings1)<-colnames(data@geno)

barplot(abs(loadings1[,1]),las=2)

barplot(abs(loadings1[,2]))

#####################

#Code to look at market type and principal components

blups\_end <- read.csv("C:/Users/tiger/Dropbox/Re-RunWGCNA\_Data\_withOwen/residual analysis/blups\_with\_enduse.csv")

#blups\_end$clone

#blups\_end$use

intersectgeno<-intersect(rownames(geno),blups\_end$clone)

geno<-data@geno

geno<-geno[rownames(geno)%in%intersectgeno,]

blups\_end<-blups\_end[blups\_end$clone%in%intersectgeno,]

geno<-geno[match(blups\_end$clone,rownames(geno)),]

Mc<-scale(geno)

sum(is.na(Mc[!which(is.na(blups\_end$use)),]))

######loadings and DAPCA

dapcout<-dapc(Mc, grp=blups\_end$use,n.pca=3,n.da=2)

scatter(dapcout)

loadingplot(dapcout$var.contr)

plot(abs(dapcout$pca.loadings[,1]))

#3 Calculating network Analysis with using WGCNA

library(WGCNA)

library(data.table)

library(stringr)

# If you have expressions and traits in one file, use this to read in. I'm not using it because expressions arent in teh same file

#data <- fread("C:/Users/Mikhail/Downloads/spec\_blup\_all.csv", header=T, stringsAsFactors=F)

#datNames <- names(data)

#datNamesCheck <- str\_detect(datNames, "C\\d+$")

#datExpr0 <- data[,datNames[datNamesCheck],with=F]

#rownames(datExpr0) <- data[,Name]

#datTrait <- data[,datNames[!datNamesCheck],with=F]

# If you have expressions aka genetic data in their own file, use this to read in

data <- read.table("C:/Users/tiger/Dropbox/Re-RunWGCNA\_Data\_withOwen/residual\_WGCNA\_122018/blups\_residual2.csv", sep=",", header=T, stringsAsFactors=F)

datExpr0 <- data[,-1]

#saves rownames to be used late

rownames(datExpr0) <- data$clone

# Check for missing values in expressions; #True is good, meaning no missing data

gsg = goodSamplesGenes(datExpr0, verbose = 3);

gsg$allOK

# Check for outliers in expressions; # Plot the sample tree: Open a graphic output window of size 12 by 9 inches

# The user should change the dimensions if the window is too large or too small.

sampleTree = hclust(dist(datExpr0), method = "average");

sizeGrWindow(12,9)

#pdf(file = "Plots/sampleClustering.pdf", width = 12, height = 9);

par(cex = 0.6);

par(mar = c(0,4,2,0))

plot(sampleTree, main = "Sample clustering to detect outliers", sub="", xlab="", cex.lab = 1.5,

 cex.axis = 1.5, cex.main = 2)

# Cut to remove outliers in expressions

abline(h=30, col='red')

clust = cutreeStatic(sampleTree, cutHeight = 30, minSize = 10)

table(clust)

keepSamples = (clust %in% c(1,2))

datExpr = datExpr0[keepSamples, ]

newRowNames <- rownames(datExpr0)[clust %in% c(1,2)]

rownames(datExpr) <- newRowNames

nGenes = ncol(datExpr)

nSamples = nrow(datExpr)

#shows you what got cut

rownames(datExpr0)[clust==0]

# Check cut in expressions

rownames(datExpr0)[!(rownames(datExpr0) %in% rownames(datExpr))]

# If you have traits in their own file, use this to read those in

#For this analysis traitData\_all will have all the phenotype and traitData\_chip will be just for chipping

traitData\_all <- fread("C:/Users/tiger/Dropbox/Re-RunWGCNA\_Data\_withOwen/residual\_WGCNA\_122018/solcap\_pheno\_final\_new18\_withalljeffpheno.csv", sep=",", header=T, stringsAsFactors=F)

#All of this is unecessary since all of those edits were done in csv file before

#traitData[,Name:=str\_replace(Name, "\_$", "")]

#traitData[,c("Chip\_Rep\_Avg\_1","Chip\_Rep\_Avg\_2"):=list(mean(Chip\_Rep1),mean(Chip\_Rep2)),by=Clone]

#traitData <- unique(traitData[,!c("Chip\_Rep1","Chip\_Rep2"),with=F])

#NY chip av column codes as character but it needs to be as numeric

traitData\_all$NY\_Chip\_AV <- as.numeric(as.character(traitData\_all$NY\_Chip\_AV))

nrow(traitData\_all)

head(traitData\_all)

traitData\_all$clone

#Now we read in traitData\_chip which will be used for making just chipping heatmap

#Need to convert NY chip to numeric

traitData\_chip <- fread("C:/Users/tiger/Dropbox/Re-RunWGCNA\_Data\_withOwen/residual\_WGCNA\_122018/chip\_phenotype\_all\_withenduse.csv", sep=",", header=T, stringsAsFactors=F)

nrow(traitData\_chip)

head(traitData\_chip)

traitData\_chip$clone

traitData\_chip$NY\_Chip\_Av <- as.numeric(as.character(traitData\_chip$NY\_Chip\_Av))

#Recluster the data and make a heatmap for all pheno

metabolites = rownames(datExpr)

traitRows = match(metabolites, traitData\_all[,clone])

datTraits\_all = traitData\_all[traitRows, !c("clone"), with=F]

rownames(datTraits\_all) = traitData\_all[traitRows, clone]

sampleTree2 = hclust(dist(datExpr), method = "average")

traitColors\_all = numbers2colors(datTraits\_all, signed = FALSE);

# Convert traits to a color representation: white means low, red means high, grey means missing entry

# Plot the sample dendrogram and the colors underneath.

plotDendroAndColors(sampleTree2, traitColors\_all,

 groupLabels = names(datTraits\_all),

 main = "Sample dendrogram and trait heatmap",

 cex.lab = 1.5,

 cex.axis = 1.5, cex.main = 2)

#Recluster the data and make a heatmap for just chipping pheno

metabolites = rownames(datExpr)

traitRows\_chip = match(metabolites, traitData\_chip[,clone])

datTraits\_chip = traitData\_chip[traitRows\_chip, !c("clone"), with=F]

rownames(datTraits\_chip) = traitData\_chip[traitRows\_chip, clone]

sampleTree2 = hclust(dist(datExpr), method = "average")

traitColors\_chip = numbers2colors(datTraits\_chip, signed = FALSE);

# Convert traits to a color representation: white means low, red means high, grey means missing entry

# Plot the sample dendrogram and the colors underneath.

plotDendroAndColors(sampleTree2, traitColors\_chip,

 groupLabels = names(datTraits\_chip),

 main = "Sample dendrogram and trait heatmap",

 cex.lab = 1.5,

 cex.axis = 1.5, cex.main = 2)

#Start Making WGCNA network

# Choose a set of soft-thresholding powers

powers = c(c(1:10), seq(from = 12, to=20, by=2))

# Call the network topology analysis function

sft = pickSoftThreshold(datExpr, powerVector = powers, verbose = 5)

# Plot the results:

sizeGrWindow(9, 5)

par(mfrow = c(1,2));

cex1 = 0.9;

# Scale-free topology fit index as a function of the soft-thresholding power

plot(sft$fitIndices[,1], -sign(sft$fitIndices[,3])\*sft$fitIndices[,2],

 xlab="Soft Threshold (power)",ylab="Scale Free Topology Model Fit,signed R^2",type="n",

 main = paste("Scale independence"));

text(sft$fitIndices[,1], -sign(sft$fitIndices[,3])\*sft$fitIndices[,2],

 labels=powers,cex=cex1,col="red");

# this line corresponds to using an R^2 cut-off of h

abline(h=0.90,col="red")

# Mean connectivity as a function of the soft-thresholding power

plot(sft$fitIndices[,1], sft$fitIndices[,5],

 xlab="Soft Threshold (power)",ylab="Mean Connectivity", type="n",

 main = paste("Mean connectivity"))

text(sft$fitIndices[,1], sft$fitIndices[,5], labels=powers, cex=cex1,col="red")

#Based on graphs, I choose 6 as the power. Pick the power that is the closest to the Red line

#It means that the 90% of the data can be sorted at that power

softPower = 6;

adjacency = adjacency(datExpr, power = softPower);

# Turn adjacency into topological overlap

TOM = TOMsimilarity(adjacency);

dissTOM = 1-TOM

#Call the hierarchical clustering function

geneTree = hclust(as.dist(dissTOM), method = "average");

# Plot the resulting clustering tree (dendrogram)

sizeGrWindow(12,9)

plot(geneTree, xlab="", sub="", main = "Gene clustering on TOM-based dissimilarity",

 labels = FALSE, hang = 0.04);

# We like large modules, so we set the minimum module size relatively high

#After WGCNA updated it became more conservative

minModuleSize = 5;

# Module identification using dynamic tree cut:

dynamicMods = cutreeDynamic(dendro = geneTree, distM = dissTOM,

 deepSplit = 2, pamRespectsDendro = FALSE,

 minClusterSize = minModuleSize);

table(dynamicMods) #lets you see all the modules and how many of metabolites are in each module

#Convert numeric lables into colors

dynamicColors = labels2colors(dynamicMods)

table(dynamicColors)

# Plot the dendrogram and colors underneath

sizeGrWindow(8,6)

plotDendroAndColors(geneTree, dynamicColors, "Dynamic Tree Cut",

 dendroLabels = FALSE, hang = 0.03,

 addGuide = TRUE, guideHang = 0.05,

 main = "Gene dendrogram and module colors")

# Calculate eigengenes

MEList = moduleEigengenes(datExpr, colors = dynamicColors)

MEs = MEList$eigengenes

# Calculate dissimilarity of module eigengenes

MEDiss = 1-cor(MEs);

# Cluster module eigengenes

METree = hclust(as.dist(MEDiss), method = "average");

# Plot the result

sizeGrWindow(7, 6)

plot(METree, main = "Clustering of module eigengenes",

 xlab = "", sub = "")

MEDissThres = 0.25

# Plot the cut line into the dendrogram

abline(h=MEDissThres, col = "red")

# Call an automatic merging function

merge = mergeCloseModules(datExpr, dynamicColors, cutHeight = MEDissThres, verbose = 3)

# The merged module colors

mergedColors = merge$colors;

# Eigengenes of the new merged modules:

mergedMEs = merge$newMEs;

#to plot new cut modules

sizeGrWindow(12, 9)

#pdf(file = "Plots/geneDendro-3.pdf", wi = 9, he = 6)

plotDendroAndColors(geneTree, cbind(dynamicColors, mergedColors),

 c("Dynamic Tree Cut", "Merged dynamic"),

 dendroLabels = FALSE, hang = 0.03,

 addGuide = TRUE, guideHang = 0.05)

#dev.off()

# Rename to moduleColors

moduleColors = mergedColors

# Construct numerical labels corresponding to the colors

colorOrder = c("grey", standardColors(50));

moduleLabels = match(moduleColors, colorOrder)-1;

MEs = mergedMEs;

# Save module colors and labels for use in subsequent parts

save(MEs, moduleLabels,datExpr, moduleColors, geneTree, file = "corey\_wgcna\_cytoscape\_residuals\_2018.RData")

#Add first column as names back

clone <- rownames(datExpr)

MEs <- cbind(clone, MEs)

write.table(moduleColors, file="moduleColors\_wgcna\_residualsonblups\_2018.csv", quote=F, row.names=T, col.names=F, sep=',')

write.table(MEs, file="module\_eigenvalues\_corey\_wgcna\_transformed\_corey\_cytoscape\_2\_20\_18.csv", quote=F, row.names=F, col.names=T, sep=',')

#Working on correlations between modules and traits

# Define numbers of genes and samples

nGenes = ncol(datExpr);

nSamples = nrow(datExpr);

# Recalculate MEs with color labels

MEs0 = moduleEigengenes(datExpr, moduleColors)$eigengenes

MEs = orderMEs(MEs0)

#This is for heatmap with all pheno so it uses DatTraits\_all

moduleTraitCor = cor(MEs, datTraits\_all, use = "p");

moduleTraitPvalue = corPvalueStudent(moduleTraitCor, nSamples);

sizeGrWindow(20,12)

# Will display correlations and their p-values

textMatrix = paste(signif(moduleTraitCor, 2), "\n(",

 signif(moduleTraitPvalue, 1), ")", sep = "");

textMatrix = str\_replace\_all(textMatrix, "\n", " ")

dim(textMatrix) = dim(moduleTraitCor)

#Need to generate figure that can be seen

# png("D:/mweas/Documents/Anna's data analysis/module\_heatmap\_allpheno.png", width=2400, height=2000)

# FOR PNG EXPORT, change to cex.text = 2, cex.lab = 2

pdf("C:/Users/tiger/Dropbox/Re-RunWGCNA\_Data\_withOwen/residual\_WGCNA\_122018/module\_heatmap\_allpheno.pdf", 10, 10)

# FOR PDF EXPORT, change to cex.text = 0.45, cex.lab = 0.5

par(mar = c(10, 12, 3, 3));

labeledHeatmap(Matrix = moduleTraitCor,

 xLabels = names(datTraits\_all),

 yLabels = names(MEs),

 ySymbols = names(MEs),

 colorLabels = FALSE,

 colors = blueWhiteRed(50),

 textMatrix = textMatrix,

 setStdMargins = FALSE,

 cex.text = 0.45,

 cex.lab = 0.5,

 zlim = c(-1,1),

 main = paste("Module vs. Phenotypes heatmap"))

dev.off()

#This is for heatmap with just chipping so it uses DatTraits\_chip

moduleTraitCor\_chip = cor(MEs, datTraits\_chip, use = "p");

moduleTraitPvalue\_chip = corPvalueStudent(moduleTraitCor\_chip, nSamples);

sizeGrWindow(20,12)

# Will display correlations and their p-values

textMatrix = paste(signif(moduleTraitCor\_chip, 2), "\n(",

 signif(moduleTraitPvalue\_chip, 1), ")", sep = "");

textMatrix = str\_replace\_all(textMatrix, "\n", " ")

dim(textMatrix) = dim(moduleTraitCor\_chip)

#Need to generate figure that can be seen

png("C:/Users/tiger/Dropbox/Re-RunWGCNA\_Data\_withOwen/residual\_WGCNA\_122018/module\_heatmap\_chipping.png", width=1200, height=1400)

# FOR PNG EXPORT, change to cex.text = 2, cex.lab = 1.3

# pdf("D:/mweas/Documents/Anna's data analysis/module\_heatmap\_chipping.pdf", 10, 10)

# FOR PDF EXPORT, change cex.text = 0.65, cex.lab = 0.5

par(mar = c(10, 12, 3, 3));

labeledHeatmap(Matrix = moduleTraitCor\_chip,

 xLabels = names(datTraits\_chip),

 yLabels = names(MEs),

 ySymbols = names(MEs),

 colorLabels = FALSE,

 colors = blueWhiteRed(50),

 textMatrix = textMatrix,

 setStdMargins = FALSE,

 cex.text = 2,

 cex.lab = 1.3,

 zlim = c(-1,1),

 main = paste("Module vs. Phenotypes heatmap"))

dev.off()

#to force out gene-trait significance and gene-module membership scores

modNames = substring(names(MEs), 3)

geneModuleMembership = as.data.frame(cor(datExpr, MEs, use = "p"));

MMPvalue = as.data.frame(corPvalueStudent(as.matrix(geneModuleMembership), nSamples));

names(geneModuleMembership) = paste("MM", modNames, sep="");

names(MMPvalue) = paste("p.MM", modNames, sep="");

geneTraitSignificance = as.data.frame(cor(datExpr, datTraits\_all, use = "p"));

GSPvalue = as.data.frame(corPvalueStudent(as.matrix(geneTraitSignificance), nSamples));

names(geneTraitSignificance) = paste("GS.", names(datTraits\_all), sep="");

# DOUBLE CHECK THAT THIS CHANGE IS RIGHT

# In line below, changed names(MEs) to names(datTraits\_all)

names(GSPvalue) = paste("p.GS.", names(datTraits\_all), sep="");

#add the write.csv directions

write.table(geneModuleMembership, file="genemodulemembership\_2018.csv", quote=F, row.names=T, col.names=NA, sep=',')

write.table(geneTraitSignificance, file="genetraitsignif\_2018.csv", quote=F, row.names=T, col.names=NA, sep=',')

write.table(GSPvalue, file="GSPval.csv", quote=F, row.names=T, col.names=NA, sep=',')

write.table(MMPvalue, file="MMPvalue.csv", quote=F, row.names=T, col.names=NA, sep=',')

#moduleTraitCor is correlation for all phenotypes, moduleTraitcor\_chip is just for chipping phenotypes

write.table(moduleTraitCor, file="moduleTraitcorrelation\_allpheno.csv", quote=F, row.names=T, col.names=NA, sep=',')

write.table(moduleTraitCor\_chip, file="moduleTraitcorrelation\_chipping.csv", quote=F, row.names=T, col.names=NA, sep=',')

write.table(moduleTraitPvalue, file="moduletraitpvalueforallpheno.csv", quote=F, row.names=T, col.names=NA, sep=',')

write.table(moduleTraitPvalue\_chip, file="moduletraitpvalueforchiptrait.csv", quote=F, row.names=T, col.names=NA, sep=',')

#Exporting to Cytoscape

# Recalculate topological overlap if needed. I have used power 6 because that is what i used in the model before. I have tried to do it for all modules

#The error I get when I try to do the final cytoscape export is: cannot open file; no such file or directory

TOM = TOMsimilarityFromExpr(datExpr, power = 6);

modules = c("darkorange","grey","bisque4","cyan");

probes = names(datExpr)

inModule = is.finite(match(moduleColors, modules));

modProbes = probes[inModule];

modTOM = TOM[inModule, inModule]

dimnames(modTOM) = list(modProbes, modProbes)

#cyt = exportNetworkToCytoscape(modTOM,

# edgeFile = paste("CytoscapeInput-edges-\_phenoall",

# paste(modules, collapse = "-"), ".txt", sep = ""),

# nodeFile = paste ("CytoscapeInput-nodes-\_phenoall", paste(modules,collapse = "-"), ".txt", sep = ""),

# weighted = TRUE,

# threshold = 0.01,

# nodeNames = modProbes,

# nodeAttr = moduleColors[inModule])

cyt = exportNetworkToCytoscape(modTOM,

 edgeFile = "CytoscapeInput-edges-glycoalkaloids\_residual.txt",

 nodeFile = "CytoscapeInput-nodes-glycoalkaloids\_residual.txt",

 weighted = TRUE,

 threshold = 0.01,

 nodeNames = modProbes,

 nodeAttr = moduleColors[inModule])

#doing cytoscape export for test modules this worked

modules\_test = c("darkgrey","salmon","darkturquoise","lightyellow","grey60");

probes = names(datExpr)

inModule = is.finite(match(moduleColors, modules));

modProbes = probes[inModule];

modTOM = TOM[inModule, inModule]

dimnames(modTOM) = list(modProbes, modProbes)

cyt = exportNetworkToCytoscape(modTOM,

 edgeFile = paste("CytoscapeInput-edges-\_test",

 paste(modules\_test, collapse = "-"), ".txt", sep = ""),

 nodeFile = paste ("CytoscapeInput-nodes-\_glycoalkaloid\_test", paste(modules\_test,collapse = "-"), ".txt", sep = ""),

 weighted = TRUE,

 threshold = 0.01,

 nodeNames = modProbes,

 nodeAttr = moduleColors[inModule])

#Exporting modules for chipping to cytoscape

modules = c("blue", "lightyellow", "green", "grey60", "purple");

probes = names(datExpr)

inModule = is.finite(match(moduleColors, modules));

modProbes = probes[inModule];

modTOM = TOM[inModule, inModule]

dimnames(modTOM) = list(modProbes, modProbes)

cyt = exportNetworkToCytoscape(modTOM,

 edgeFile = paste("CytoscapeInput-edges-\_chipping",

 paste(modules, collapse = "-"), ".txt", sep = ""),

 nodeFile = paste ("CytoscapeInput-nodes-\_chipping", paste(modules, collapse = "-"), ".txt", sep = ""),

 weighted = TRUE,

 threshold = 0.01,

 nodeNames = modProbes,

 nodeAttr = moduleColors[inModule])

con <- file("test.log")

sink(con, append=TRUE)

sink(con, append=TRUE, type="message")

source("script.R", echo=TRUE, max.deparse.length=10000)

networkConcepts(datExpr, power = 6, trait = NULL, networkType = "unsigned")

sink()

sink(type="message")

save.image(file = "cytoscapeexport\_residual\_glyc.Rdata")

#4. GWAS code using GWASpoly for module

#First make sure that you have rrblup package donwloaded then install gwasopoly package from the zipped file

install.packages(file.choose(), repos=NULL)

#Load libraries

library (rrBLUP)

library(GWASpoly)

library(stringr)

# Set folder to save to

#Need to create folders first

#select the entire curley bracket

baseFilePath <- "C:/Users/tiger/Dropbox/Re-RunWGCNA\_Data\_withOwen/residual\_GWAS\_bonferoni/"

# Empty DF to put all QTL info into

qtl <- data.frame()

# Get list of modules

file <- read.csv("module\_eigenvalues\_corey\_wgcna\_residual.csv")

colNames <- names(file)

modules <- colNames[str\_detect(colNames, "^ME")]

#make sure that you have the right number of traits listed in GWASpoly corresponding to your actual number of traits

for (i in 1:length(modules))

{

 # The current module is:

 module <- modules[i]

 #Loading required data: do not copy from manual retype

 data <- read.GWASpoly(ploidy = 4, pheno.file = "module\_eigenvalues\_corey\_wgcna\_residual.csv",

 geno.file = "genetic\_data\_solcap.csv", format="ACGT", n.traits = 45, delim = ",")

 #calculate K matrix, if you have set parameters than use set.params function,

 #i did not use param function in gwas function because I did not have fixed effects

 data2 <- set.K(data)

 #params <- set.params(fixed=c("Grp1","Grp2","Grp3","Grp4"),

 #fixed.type=rep("numeric",4))

 #Runs the model

 data3 <- GWASpoly(data2,models=c("general","additive","1-dom","2-dom"),

 traits=c(module))

 #check QQ plot for some reason have is.element (model, models is not true), I see additive and general model

 # par (mfrow) specifies a 2 x 3 panel. -dom had a space which was showing error

 par(mfrow=c(2,3))

 models <- c("additive", "general", "1-dom-alt", "1-dom-ref", "2-dom-alt","2-dom-ref")

 for( i in 1:6) {

 qq.plot(data3,trait = module, model=models[i],cex = 1)

 dev.copy(pdf, str\_c(baseFilePath, "/qqplots/", module, ".pdf"))

 dev.off()

 }

 #set QTL threshold

 data4 <- set.threshold(data3,method ="Bonferroni",level=0.05)

 #Lets you get and save significant QTL

 sig <- get.QTL(data4, traits = module)

 if (i == 1)

 {

 qtl <- sig

 } else {

 qtl <- rbind(qtl, sig)

 }

 #an example if you only wanted to get QTL for certain model types

 get.QTL(data4, traits = module)

 par(mfrow=c(1,1))

 #allows you to plot different models and manhattan plots

 manhattan.plot(data4,trait=module,model="general")

 dev.copy(pdf, str\_c(baseFilePath, "/manhattan/", module, "\_general.pdf"))

 dev.off()

 par(mfrow=c(1,1))

 manhattan.plot(data4,trait=module,model="1-dom-alt")

 dev.copy(pdf, str\_c(baseFilePath, "/manhattan/", module, "\_1-dom-alt.pdf"))

 dev.off()

 par(mfrow=c(1,1))

 manhattan.plot(data4,trait=module,model="1-dom-ref")

 dev.copy(pdf, str\_c(baseFilePath, "/manhattan/", module, "\_1-dom-ref.pdf"))

 dev.off()

 par(mfrow=c(1,1))

 manhattan.plot(data4,trait=module,model="additive")

 dev.copy(pdf, str\_c(baseFilePath, "/manhattan/", module, "\_additive.pdf"))

 dev.off()

 par(mfrow=c(1,1))

 manhattan.plot(data4,trait=module,model="2-dom-alt")

 dev.copy(pdf, str\_c(baseFilePath, "/manhattan/", module, "\_2-dom-alt.pdf"))

 dev.off()

 par(mfrow=c(1,1))

 manhattan.plot(data4,trait=module,model="2-dom-ref")

 dev.copy(pdf, str\_c(baseFilePath, "/manhattan/", module, "\_2-dom-ref.pdf"))

 dev.off()

 #How to save gwasopoly results

 write.GWASpoly(data3,module,str\_c(baseFilePath, "/gwasresults/", module, ".csv"),what = "scores", delim =",")

 write.GWASpoly(data3,module,str\_c(baseFilePath, "/gwasresults/", module, "\_effects.csv"),what = "effects", delim =",")

}

# Save QTL

write.csv(qtl,file=str\_c(baseFilePath,"qtl\_residual\_module\_bonf.csv"), row.names = FALSE)

#5. Regression on phenotypes

#Reading file

reg <- read.csv("residualmodules\_withpheno.csv", header=TRUE)

#Average the two chipping columns; Do not need to average the 2 chip column this time around

#reg$average\_chipscore <- apply(reg[,c("Chip\_Rep1", "Chip\_Rep2")], MARGIN = 1,FUN=mean, na.rm=TRUE)

#Modele for first module

mod <- lm(chip\_color~ MEblue, data=reg)

#summary(mod)#

plot(reg$MEblue,reg$chip\_color)

plot(mod, which=1) #residuals

plot(mod, which=2) #qq plot

summary(mod)$coefficients[2,4] # pvalue for summary of regression

summary(mod)$r.squared #rquared pulled

#Make the empty data frame

results <- data.frame(module=rep(NA, 45),

 Rsq=rep(NA,45),

 pvalue=rep(NA, 45))

#Make a list of ME names

modnames <- names(reg)[grep("ME", names(reg))]

#grep("ME", names(reg)) #tells you teh pattern that has ME

#make folders qq\_plot, resid\_plot, scatter\_plot

for (i in 1:45){

 mod <- lm(total\_yield ~ reg[,modnames[i]], data=reg)

 results$Rsq[i] <- summary(mod)$r.squared

 results$pvalue[i] <- summary(mod)$coefficients[2,4]

 results$module[i] <- modnames[i]

 pdf(paste("scatter\_plot\_yield/", modnames[i],".pdf", sep="")) #opens a file and writes to it until you say dev.off()

 plot(reg[,modnames[i]],reg$log10\_glucose, xlab=modnames[i], ylab="total\_yield")

 abline(mod)

 dev.off()

 pdf(paste("resid\_plot\_yield/", modnames[i],".pdf", sep="")) #opens a file and writes to it until you say dev.off()

 plot(mod, which=1)

 dev.off()

 pdf(paste("qq\_plot\_yield/", modnames[i],".pdf", sep="")) #opens a file and writes to it until you say dev.off()

 plot(mod, which=2)

 dev.off()

}

results$signif <- results$pvalue < 0.05

write.csv(results, file="regression\_of\_yield\_residualanalysis.csv")