



# A Genetic Study of Grapevine Rooting from Dormant Harwood Cuttings

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# Rooting practice

## INCREASING VINES IN THE VINEYARD



- Mark vines with good vigor/yield before harvest
- Take cutting during the dormant season (December or January)
- Store in a cold place at temps slightly above freezing ( $\sim 4^{\circ}\text{C}$ )
- Early spring, after soil warms, cuttings can be placed in nursery

# Problem

NOT ALL VINES ARE EASY TO ROOT



NO TIME TO PROPAGATE GREEN CUTTINGS

3



# Problem

## ADVENTITIOUS ROOTING

- Complex developmental process that requires plasticity to adjust to stressful conditions
- Respond to certain stimuli (moisture, minerals, light & lack thereof)
- Requires at least three processes:
  - De-differentiation (committed cells grow in reverse, unlearn, etc.)
  - Cell division (during a time they normally were not)
  - AR = root primordia initiation, development and outgrowth

# What we do

## PRECISION BREEDING (MOLECULAR)



- Cross parents of interest
- Genotype parents and progeny using DNA markers
- Identify traits of interest
- Associate DNA markers with traits of interest for future marker-assisted selection



# Principle of SSR

## Alleles

#1



11 'CA' repeats  
= 22 bases

#2



13 repeat =  
26 bases

#3



16 repeats =  
32 bases

- Forward primer
- Reverse primer
- Flanking sequence

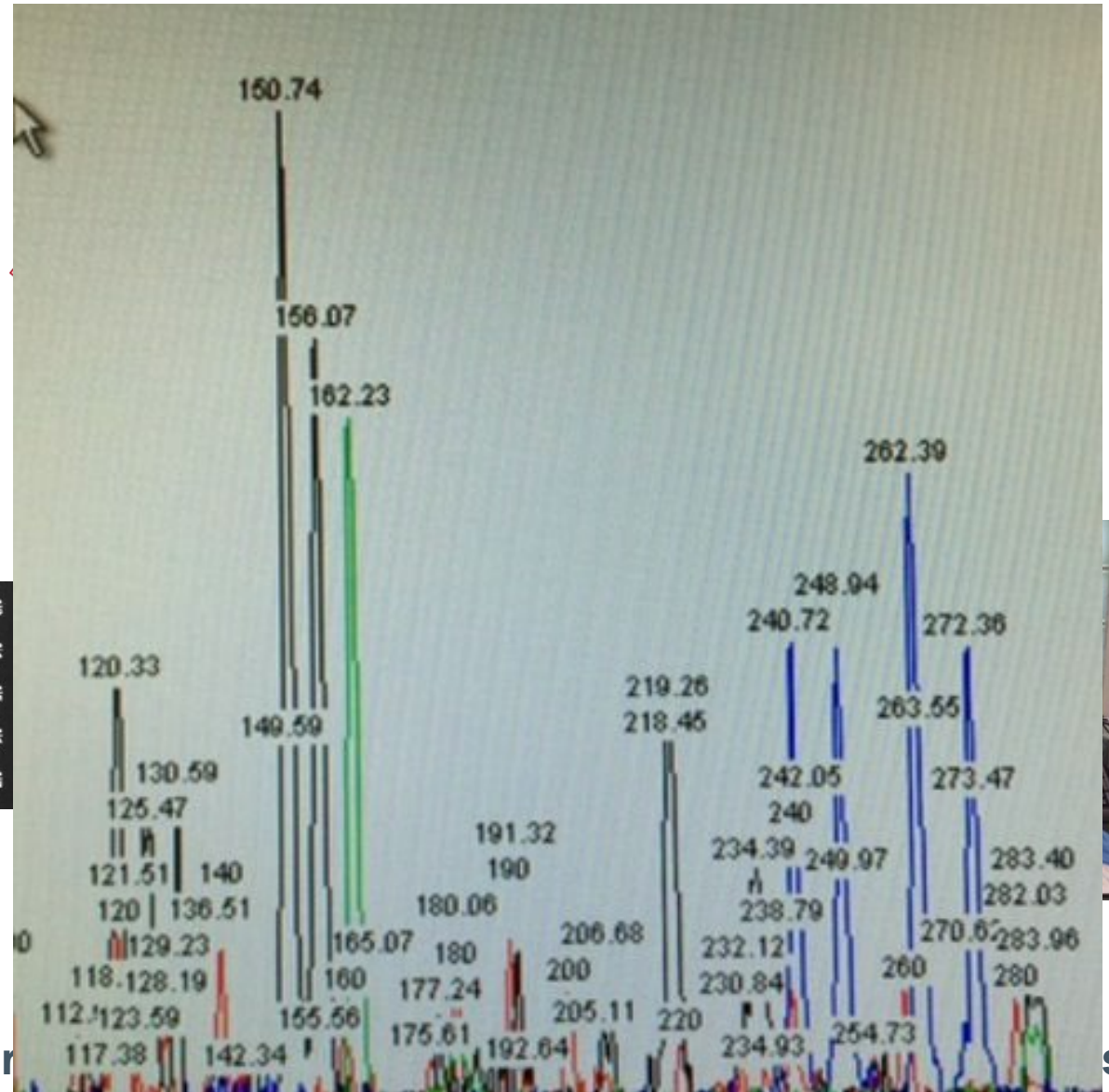
## Genotypes





# What we do

## PRECISION BREEDING (MOLECULAR)



Wor

S

7

Length of fragment



# The Cross

## HISTORY

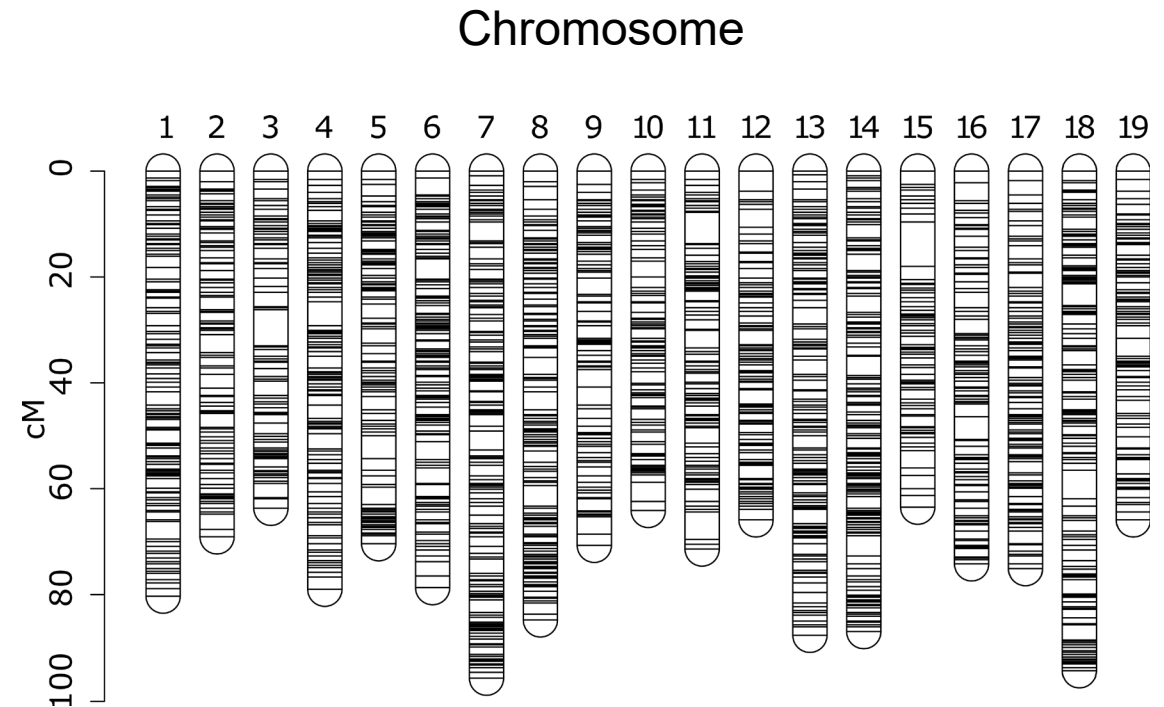
- 2005 - *Vitis aestivalis* – ‘Norton’ x *V. vinifera* – ‘Cabernet Sauvignon’  
= 74 interspecific hybrids
- 2011 – hybrid progeny were expanded to 310 genotypes
- The mapping population for this study was 189



# The Cross

## CONSENSUS LINKAGE MAP

- A map was constructed using 406 SSR markers and 1,659 single nucleotide polymorphic (SNP) markers – generated by GBS
- Map size 1,678.6 cM



# The Cross

## *VITIS AESTIVALIS* – ‘NORTON’

- Missouri’s state wine grape
- Resistant to fungal diseases
- Cold hardy
- **Difficult-to-root**

## *V. VINIFERA* – ‘CABERNET SAUVIGNON’

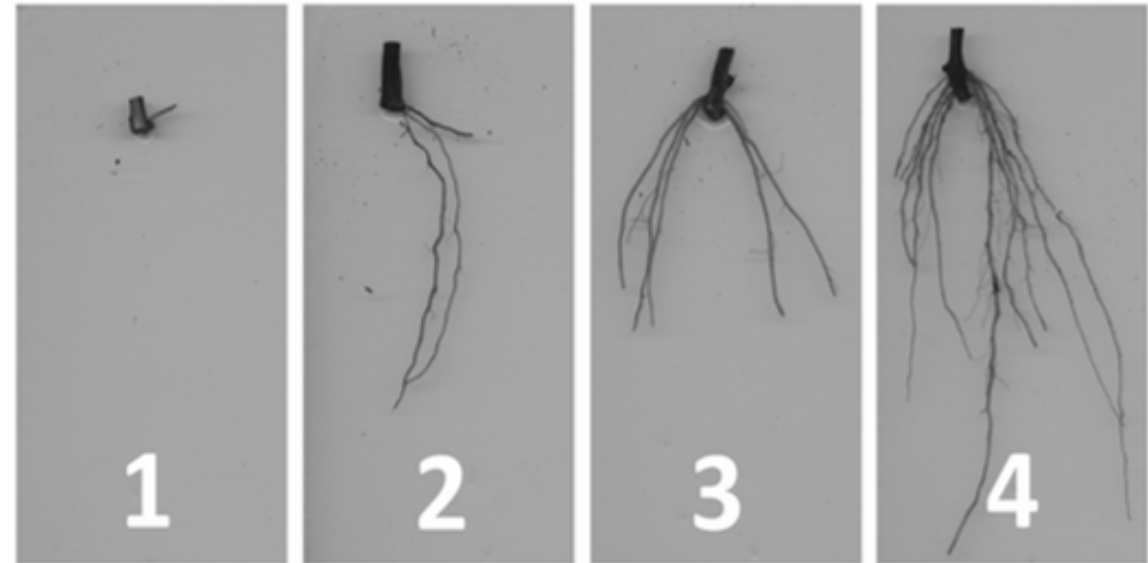
- Not resistant
- Doesn’t grow well in Missouri
- **Easy-to-root**





# The Cross

## PROGENY PHENOTYPES

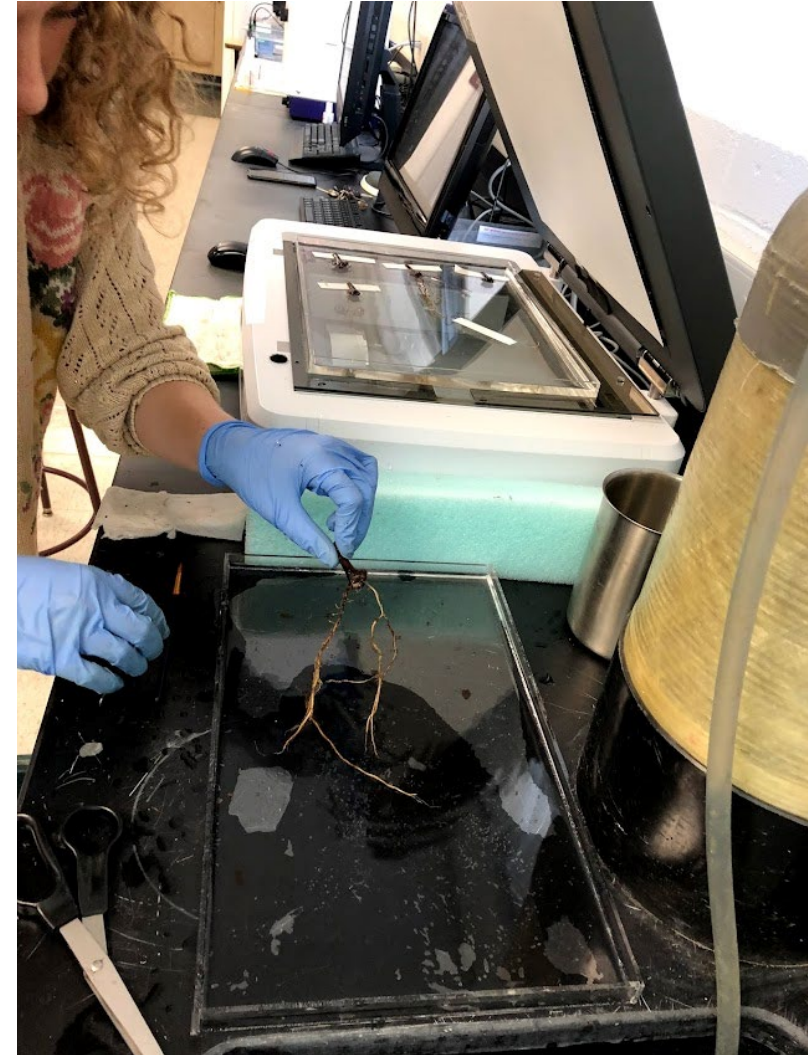


Representative phenotypes segregating for rooting ability

# Phenotyping

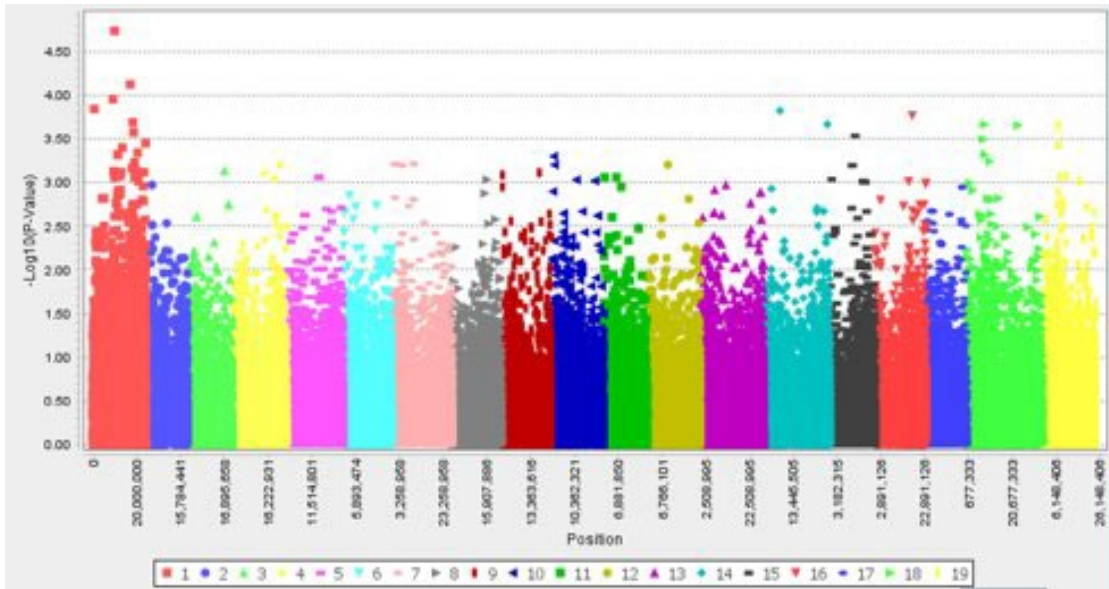
## MEASURING ROOTING ABILITY

- Average root number
- Longest root length
- Average total root length
- Lateral : Primary root ratio
- Percent rooting
- Rank 1-4



# Results

## FIRST YEAR



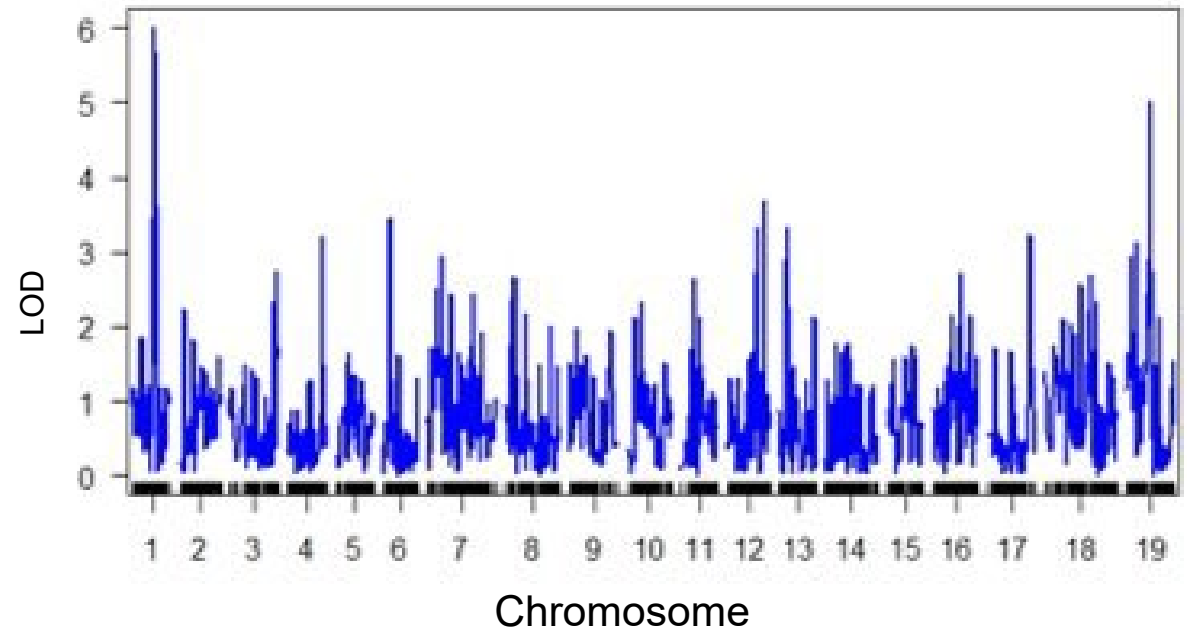
Analysis shows linkage group 1 to have the best SNP-trait association (4.7). Each colored bar represents a linkage group. Each point represents a marker on the respective linkage group

Manhattan plot using the mixed linear model in TASSEL5.0

# Results

## FIRST YEAR

- Analysis of average root number (ARN) per genotype reveals that linkage group 1 (LOD 6.13) may contain a QTL



R/QTL analysis using SSR & SNP markers



# Conclusion

## PRELIMINARY

- A potential QTL for root number has been identified on Linkage Group 1
- Flanking SSR markers for possible QTL are ctg8034 and VMCN2g7
- An additional SNP marker, between SSRs, is S1\_18502204



# Future

2022-23

- Increase density of map using new genotyping platform (rhAmpSeq)
- Add another year of data, totaling 3 years data
- Analyze the other rooting phenotypes
- Discover quantitative trait loci (QTL) for dormant rooting ability



# Thank You

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