

Assessing range-wide natural variation in Valley Oak (*Quercus lobata*) using a newly established provenance test

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Provenance tests

- Long-term common garden study in forest trees
- Sampling a number of different provenances (or sources) of trees
- Can be range-wide, or a more restricted study area
- Examine tree performance in a common garden setting
- Often multiple gardens are used

Provenance tests

- Data is collected on growth and survival at regular intervals
- Can determine which sources of trees perform best in a given environment (or environments)
 - Information that is needed to determine seed zones and seed transfer rules
 - Can explore tree responses to climate change
 - All the trees were grown in a new climate
 - Can look at how a change in climate impacts tree growth
- Are a long-term resource for a species

Provenance tests

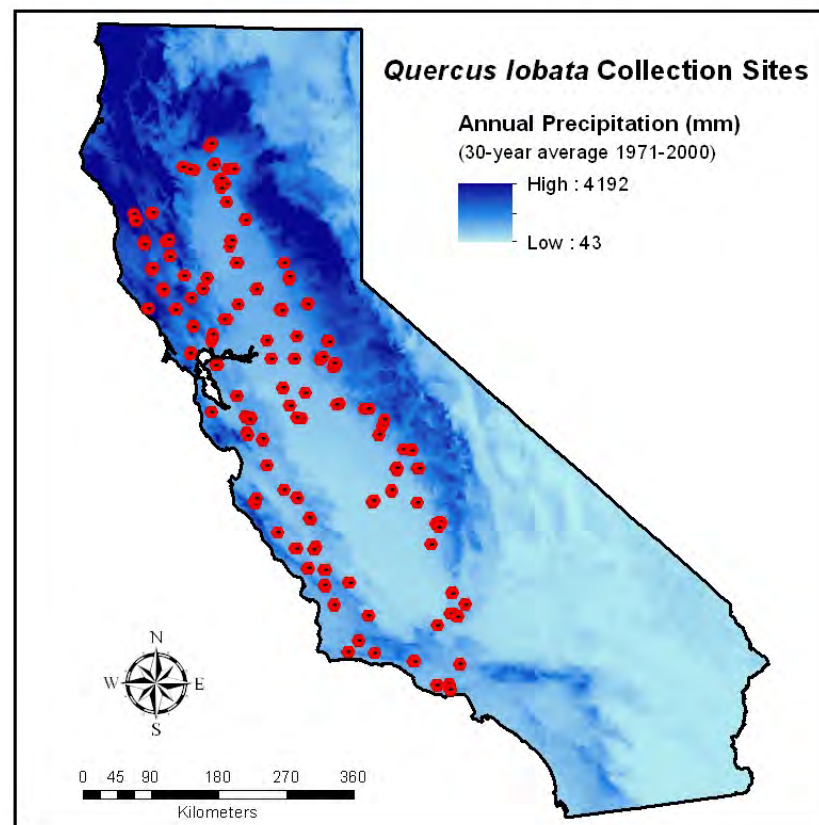
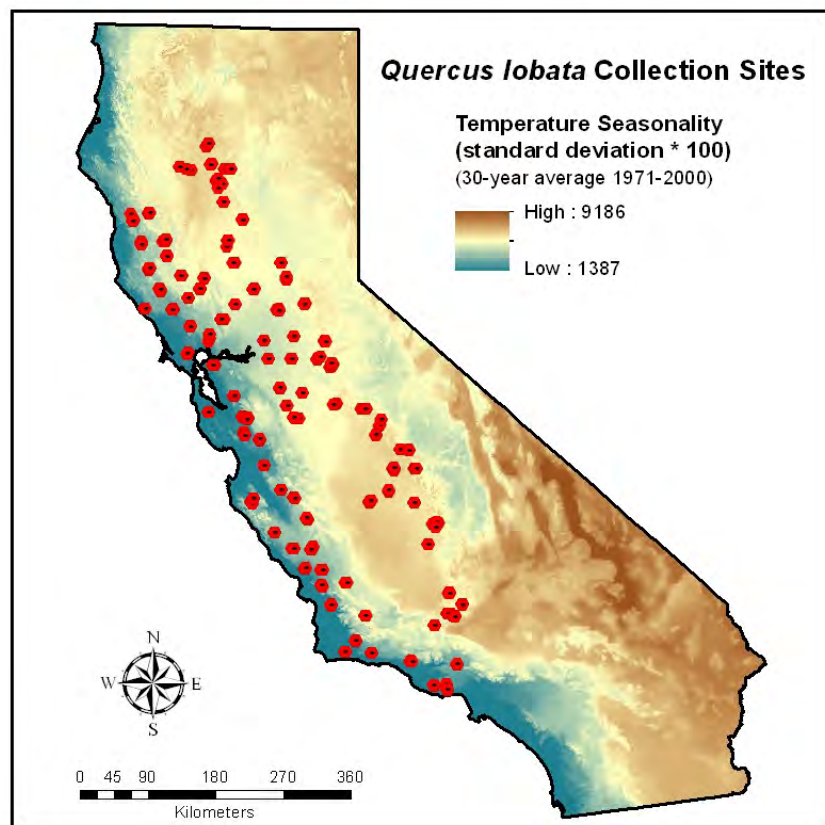
- How do different sources of trees respond to novel climates?
 - Is there genetic variation for survival and growth?
 - Is there genetic variation for traits associated with fitness
 - Drought tolerance
 - Phenology
 - Genotype X Environment??

Valley Oak Provenance test

- Valley oaks are already highly impacted by human activity
 - Housing and agriculture
- Anticipated to be highly impacted by climate change
- No provenance test resources are available for any California Oak species
 - Acorns cannot be stored long-term

Valley Oak Provenance test

- Background and methods
- First year growth data
 - Height, basal diameter, acorn weight, germination date and germination rate
 - Are there patterns in the genetic correlations?
 - Among traits
 - Between traits and the environment
- First field year (3rd growth year)
 - Are there differences in the phenology of bud burst?
 - Associate phenology data with climate data
- Future directions



95 sites
674 maternal trees

Questions:

- Are there patterns in the genetic correlations?
 - Among traits
 - Between traits and the environment

- Are there differences in the phenology of bud burst?
 - Associate phenology data with climate data





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Germination
Date

Elevation

Germination
Rate

Latitude

Genetic correlations among traits and climate

Height

MAT

Positive correlation

Basal
diameter

Negative correlation

MAP

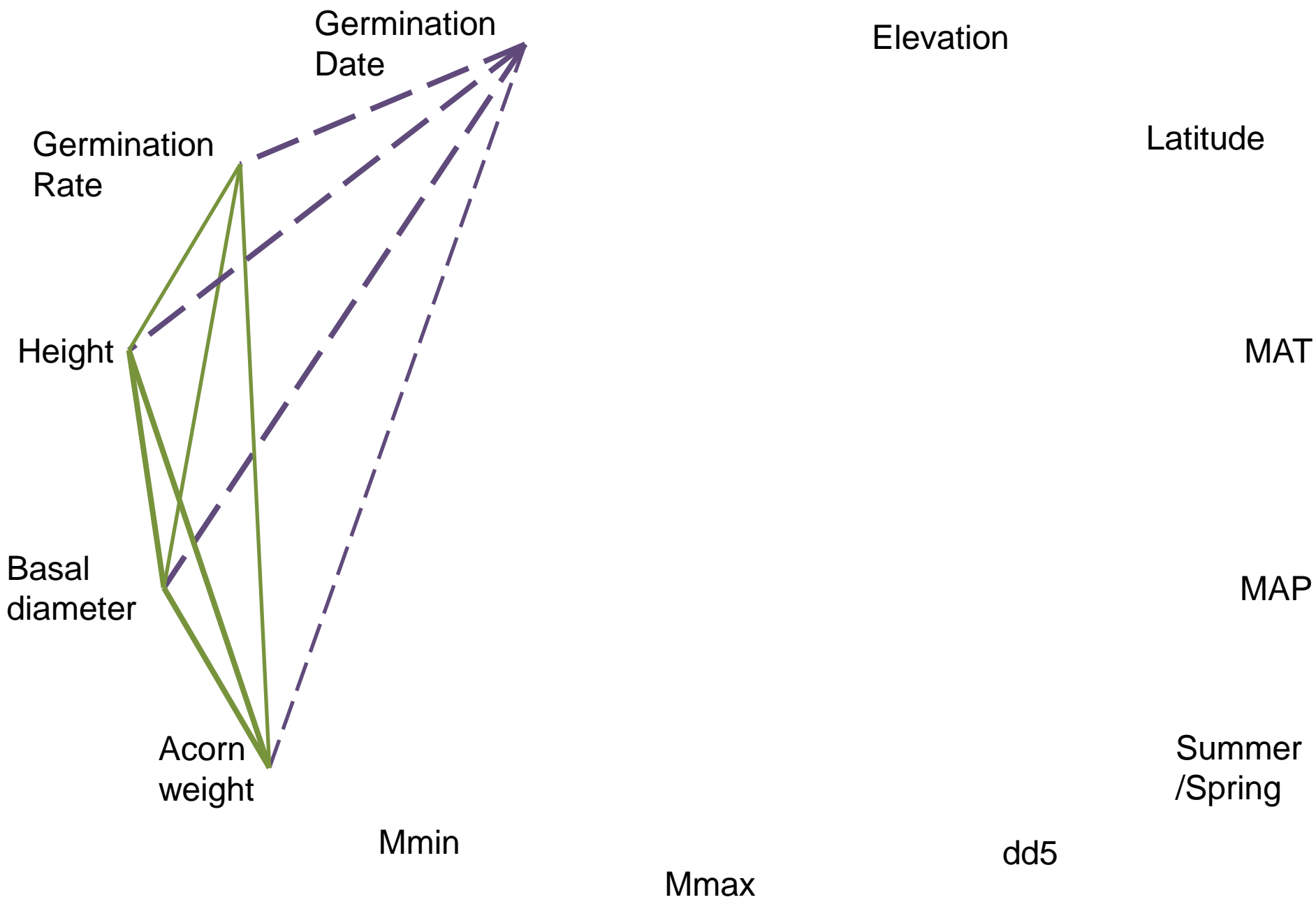
Acorn
weight

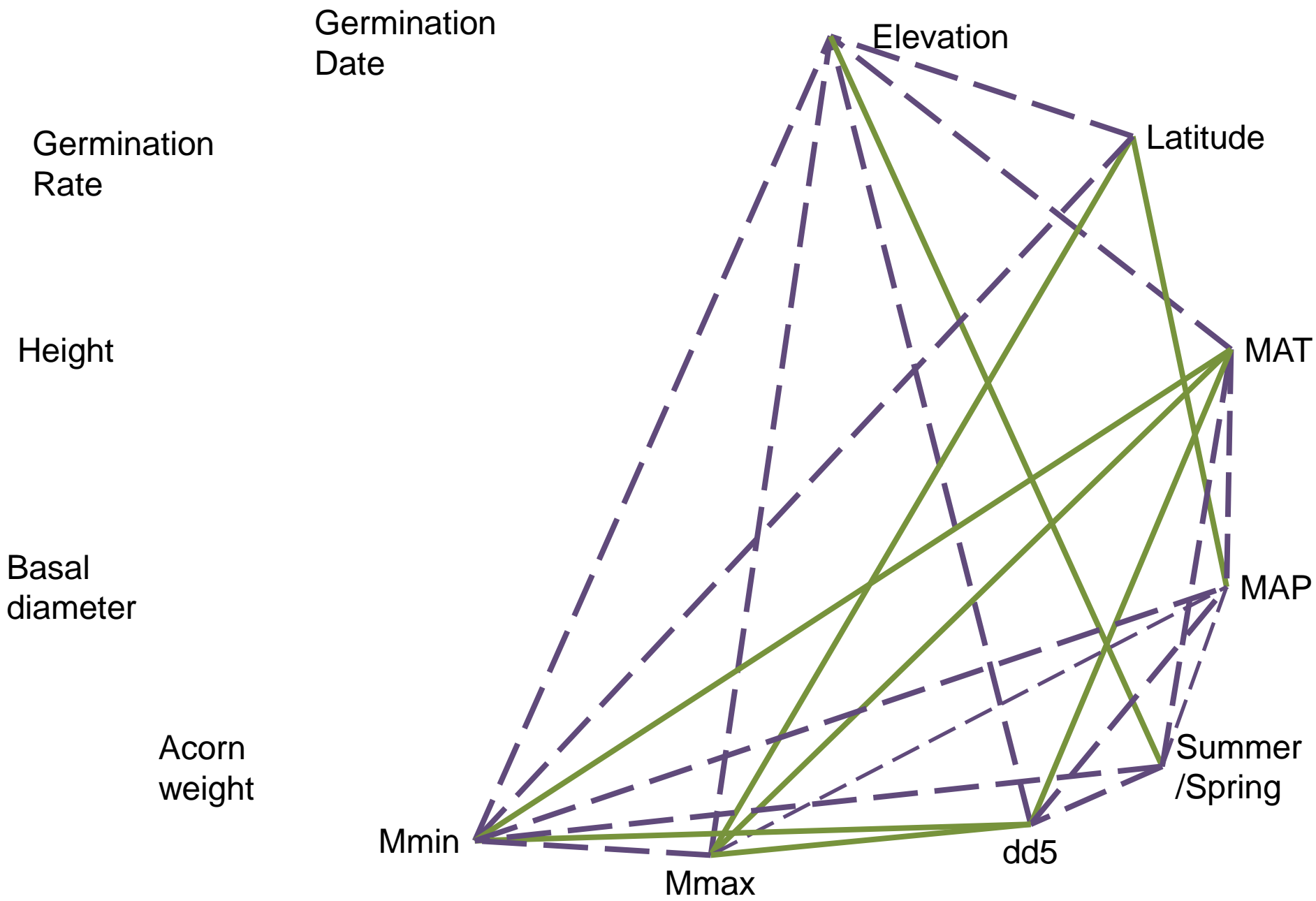
Summer
/Spring

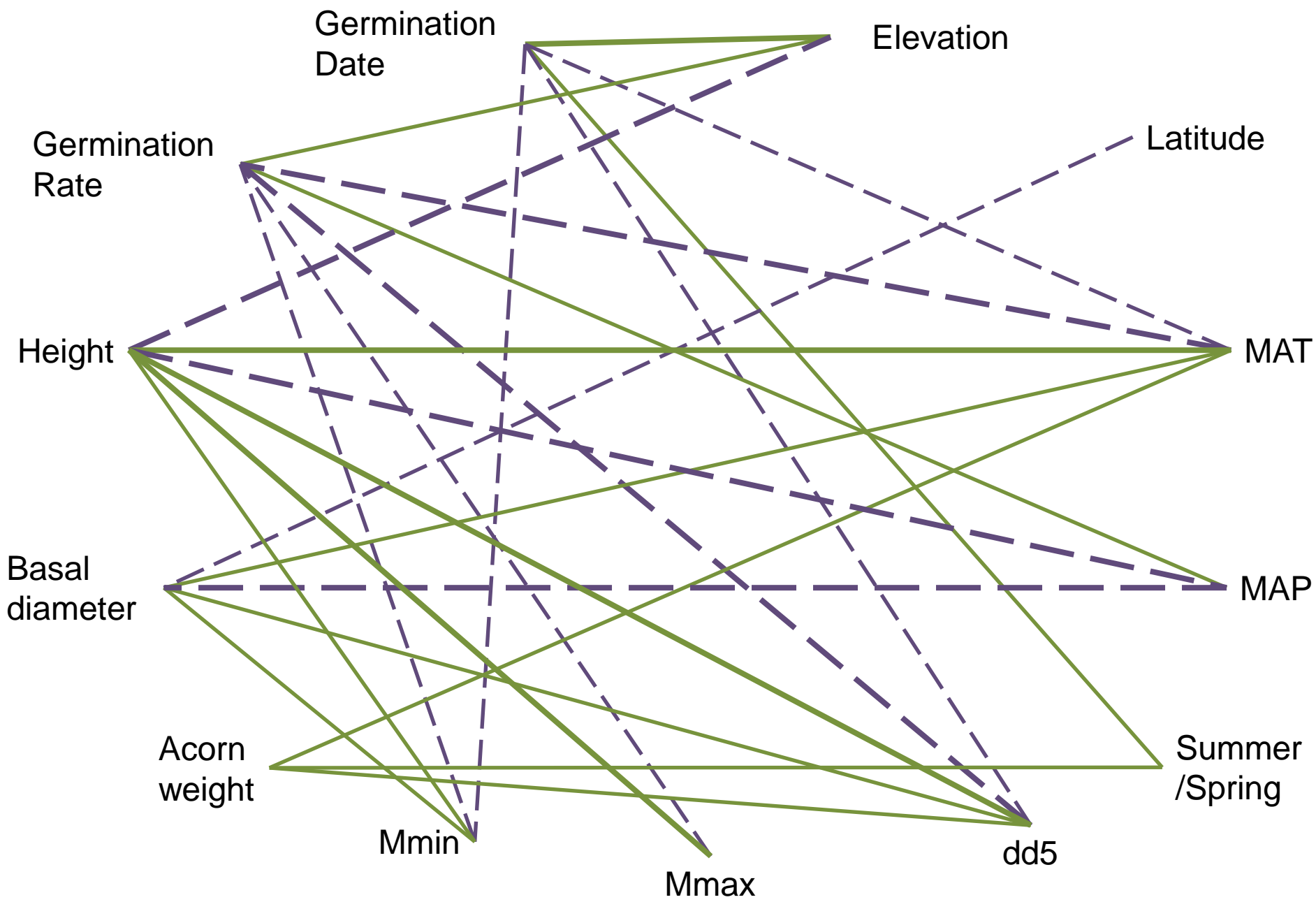
Mmin

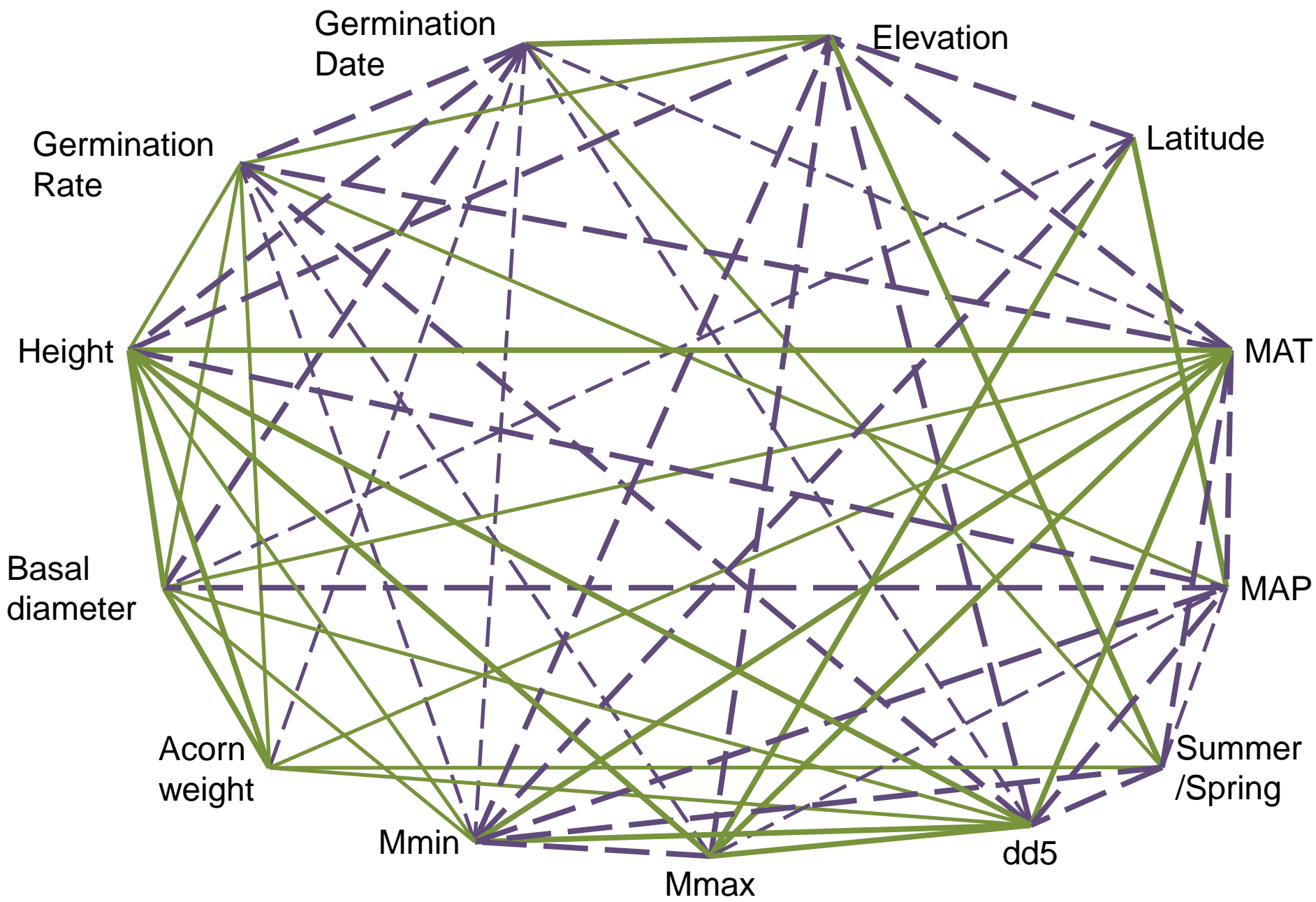
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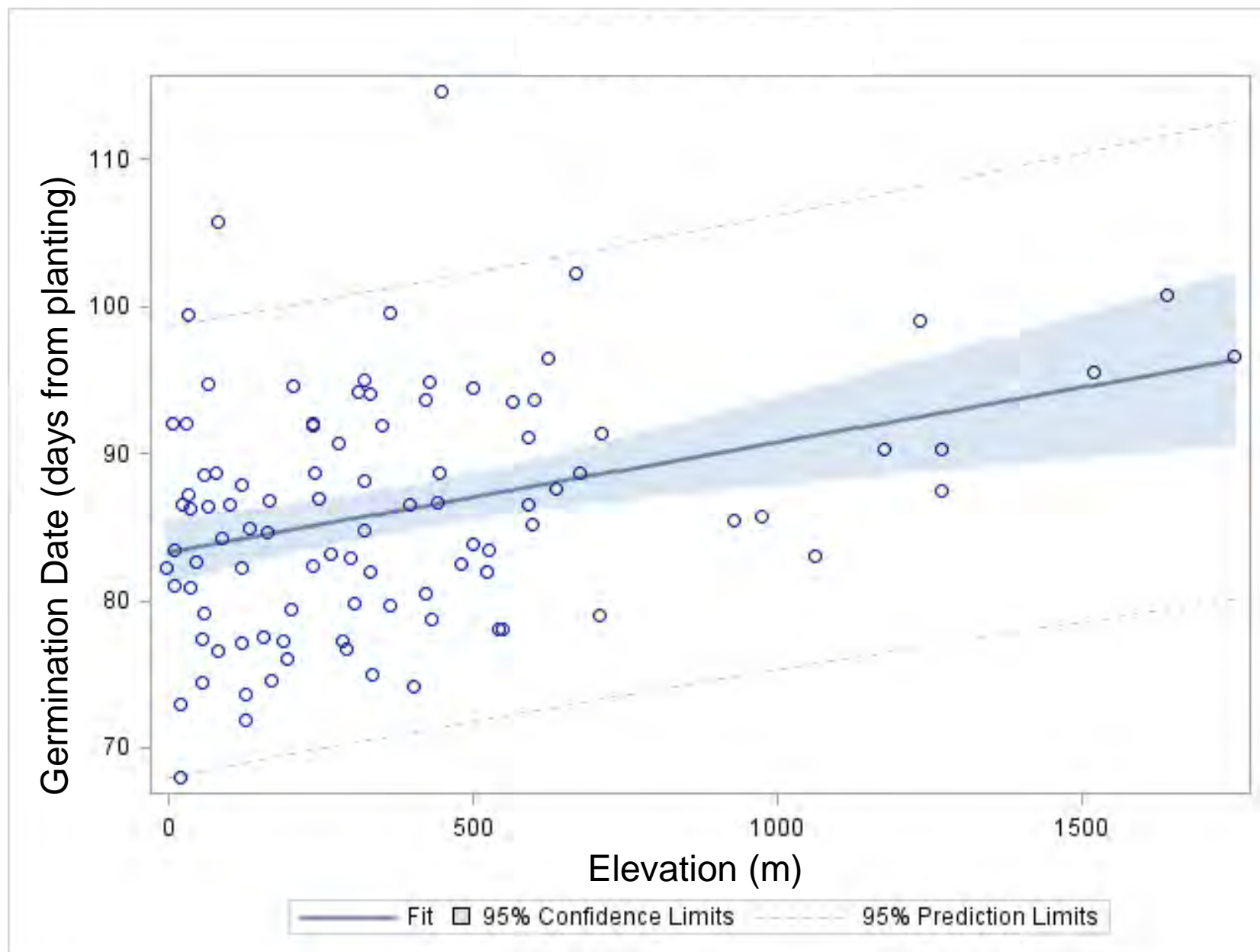
dd5

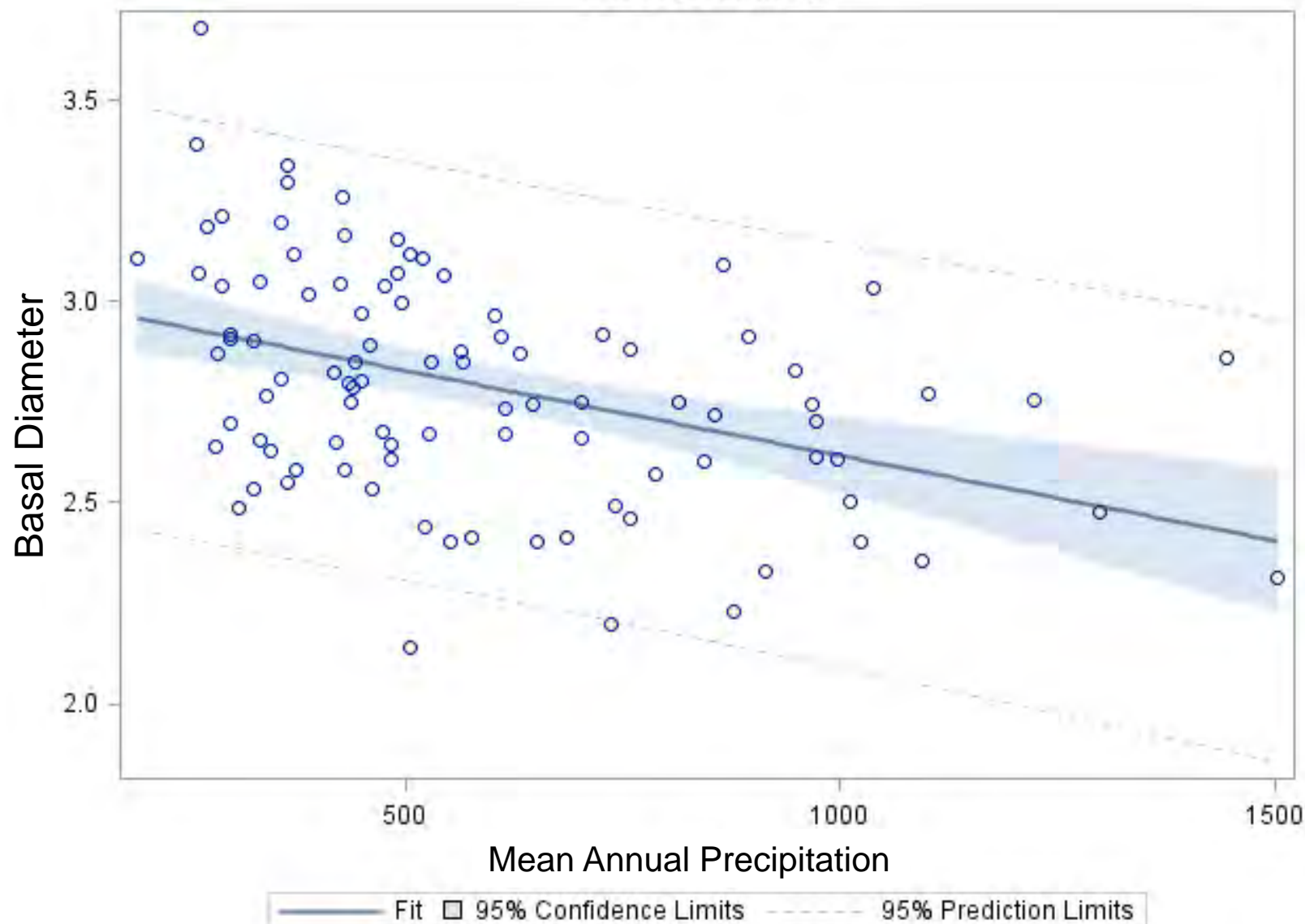












Questions:

– Are there patterns in the genetic correlations?

- Among traits
- Between traits and the environment

❖ Yes!

– Are there differences in the phenology of bud burst?

- Associate phenology data with climate data



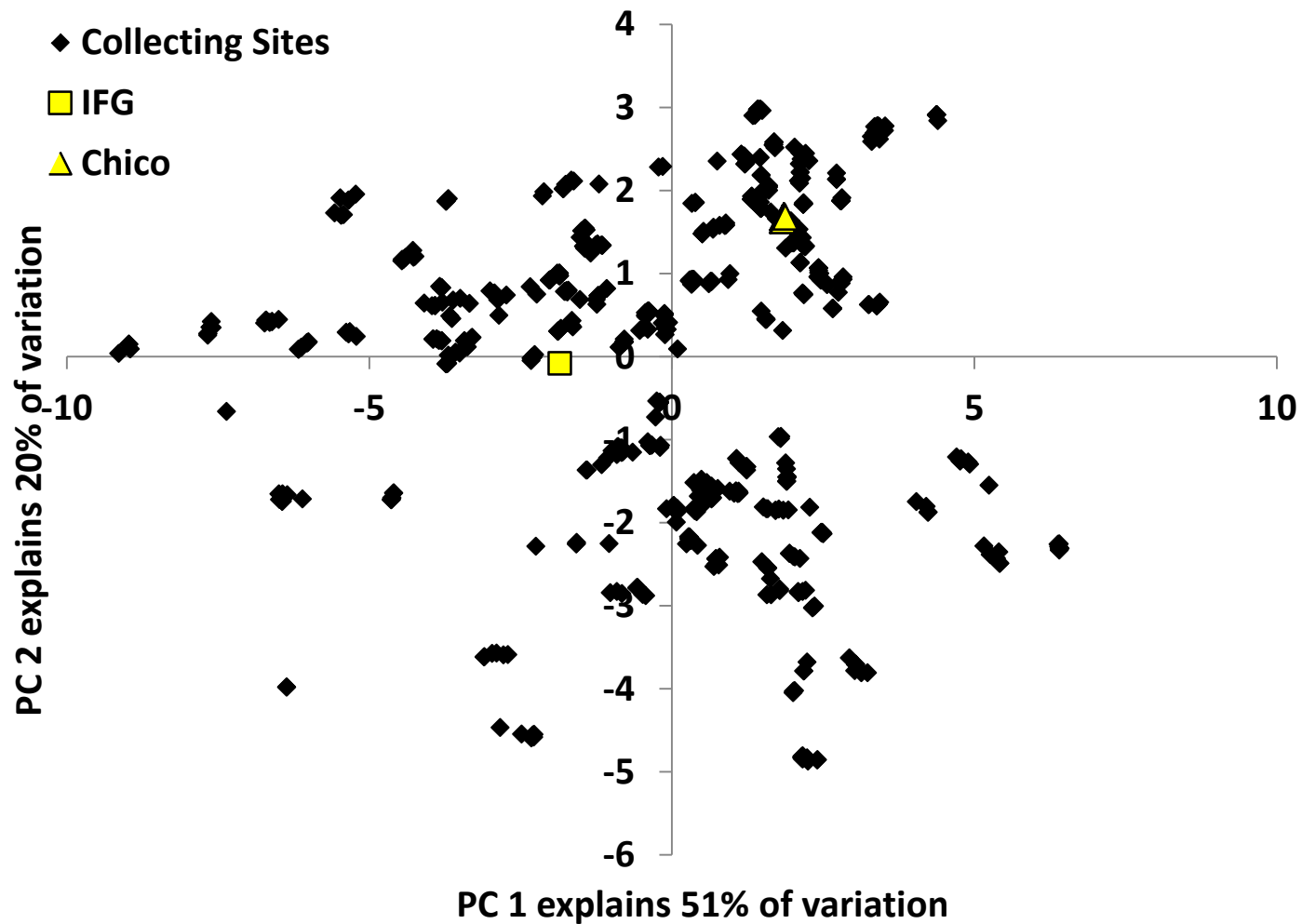




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The two planting sites represent two different valley oak climate environments.



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Future planting site at the USDA-FS PSW Institute of Forest Genetics, Placerville







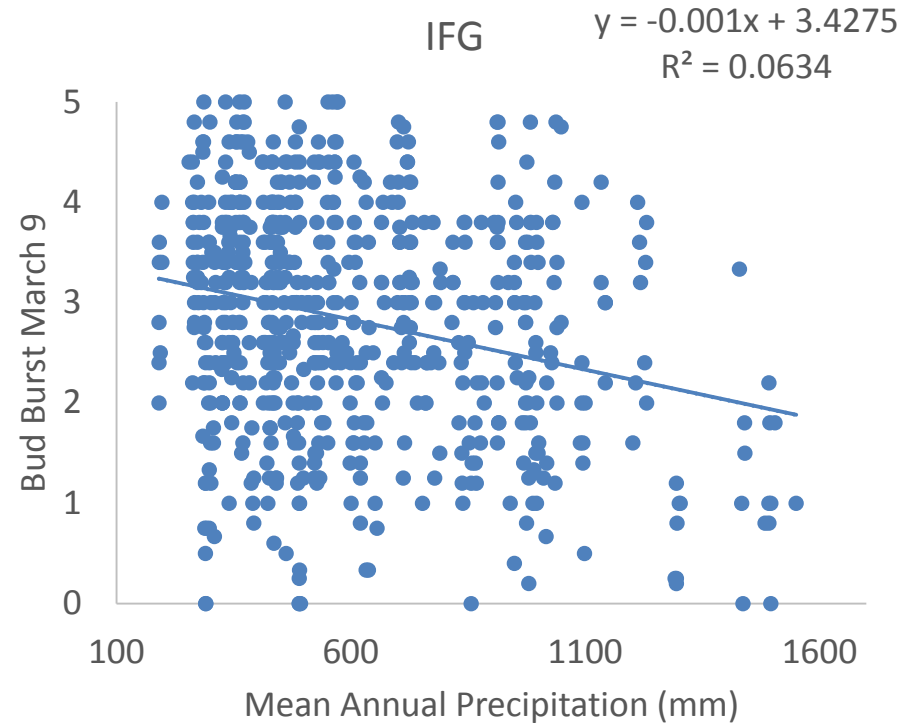
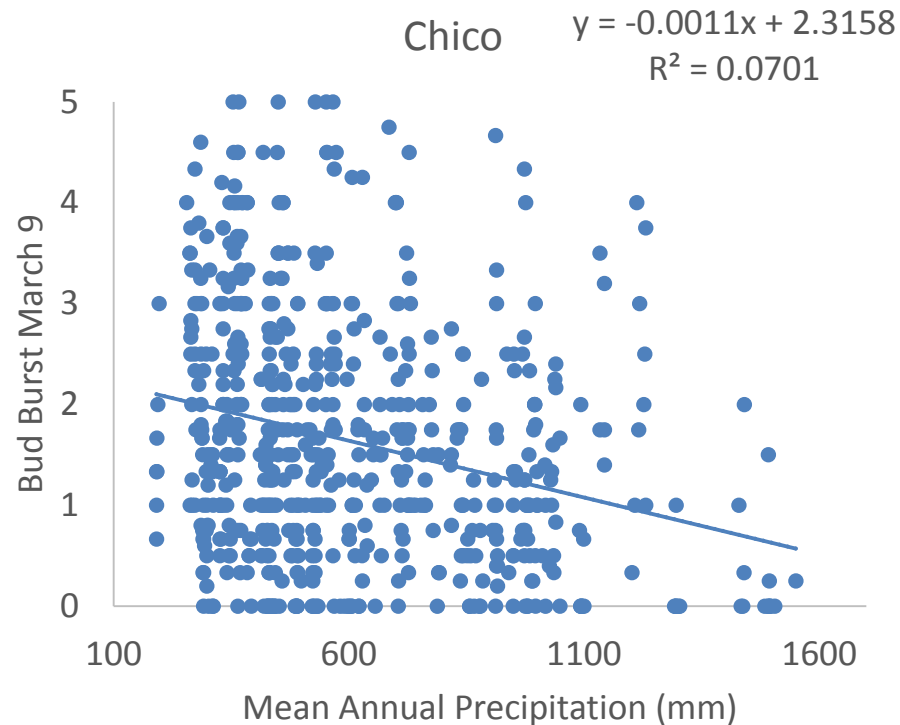


Future planting site at the USDA-FS Genetic Resource and Conservation Center, Chico



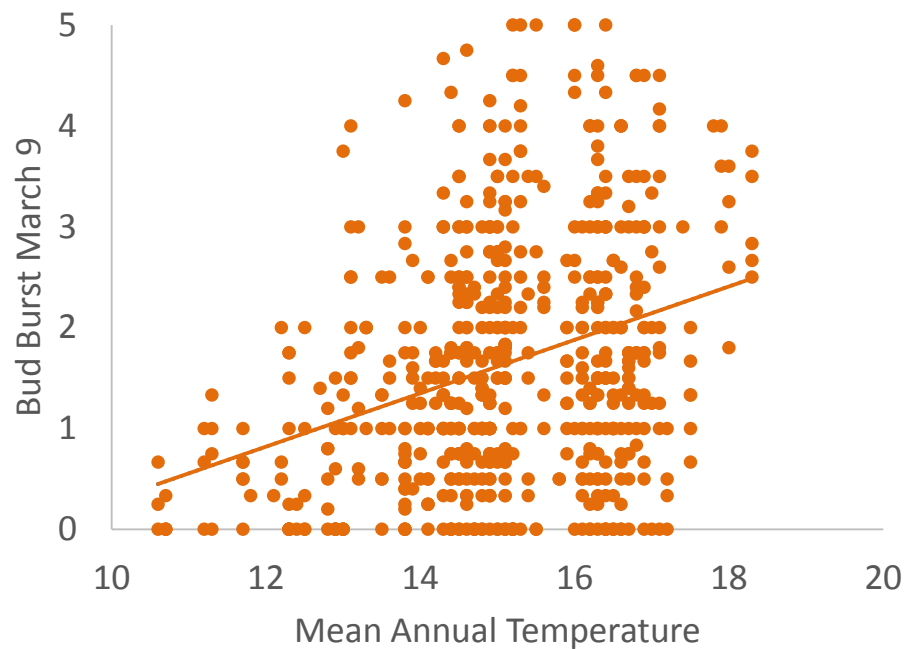


IFG had earlier bud break than Chico, but the trend lines are parallel!

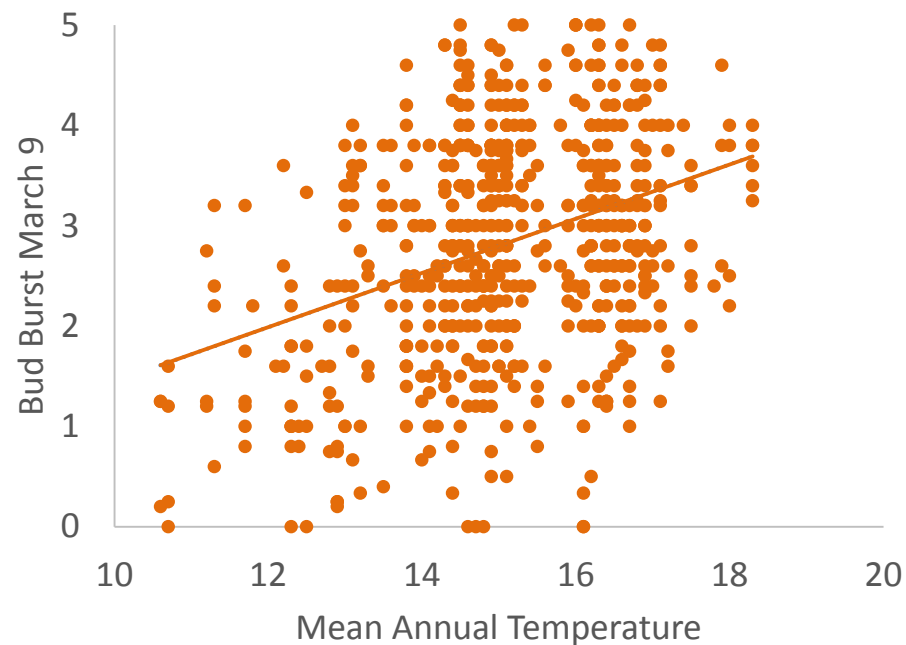


Families from drier places had earlier bud break

Chico $y = 0.2647x - 2.3548$
 $R^2 = 0.1019$

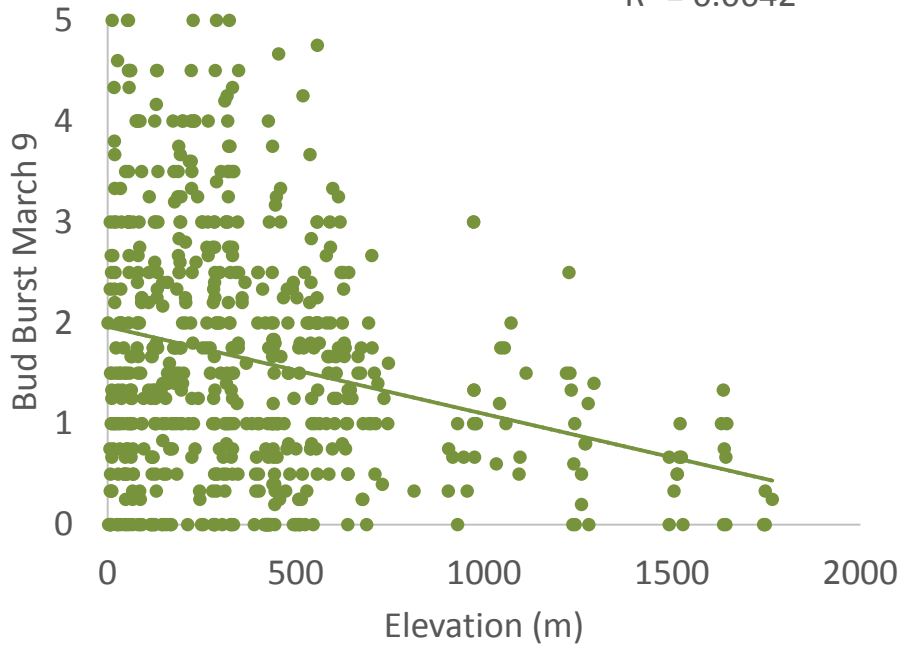


IFG $y = 0.2702x - 1.2526$
 $R^2 = 0.1242$

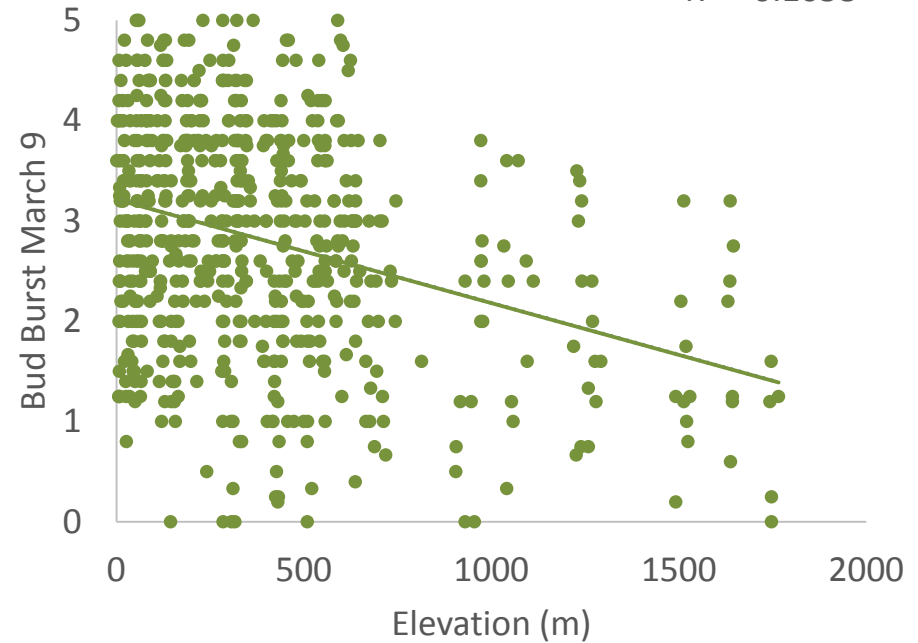


Families from warmer places had earlier bud break

Chico $y = -0.0009x + 1.9621$
 $R^2 = 0.0642$



IFG $y = -0.001x + 3.2153$
 $R^2 = 0.1058$



Families from lower elevation had earlier bud break.

Questions:

- Are there patterns in the genetic correlations?
 - Among traits
 - Between traits and the environment

❖ Yes!

- Are there differences in the phenology of bud burst?
 - Associate phenology data with climate data

❖ Yes!



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Future Directions:

Maintain provenance test

- Long-term research resource
 - Local adaptation?
 - Climate change?

Address conservation questions

- Seed transfer guidelines
- Populations of conservation concern?



Photo credit: Andrea Pluess

Develop genomic resources for the species

- GWAS
- Genotype- Environment associations



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Thank you!

PSW

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