# Establishing an awareness of ideal plant phenotype based on environmental challenges

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Exploring characteristics in different environments

- Hawai'i is very susceptible to climate change and abiotic stressors.
- Maize (*Zea mays* L.) is one of the most understood and abundant crops.
- Maize is often used as a model species to understand stress responses.

- Our objective is to evaluate physiological responses of plant and root characteristics of different genotypes sourced from a diversity panel and grown over different years and conditions in a greenhouse.
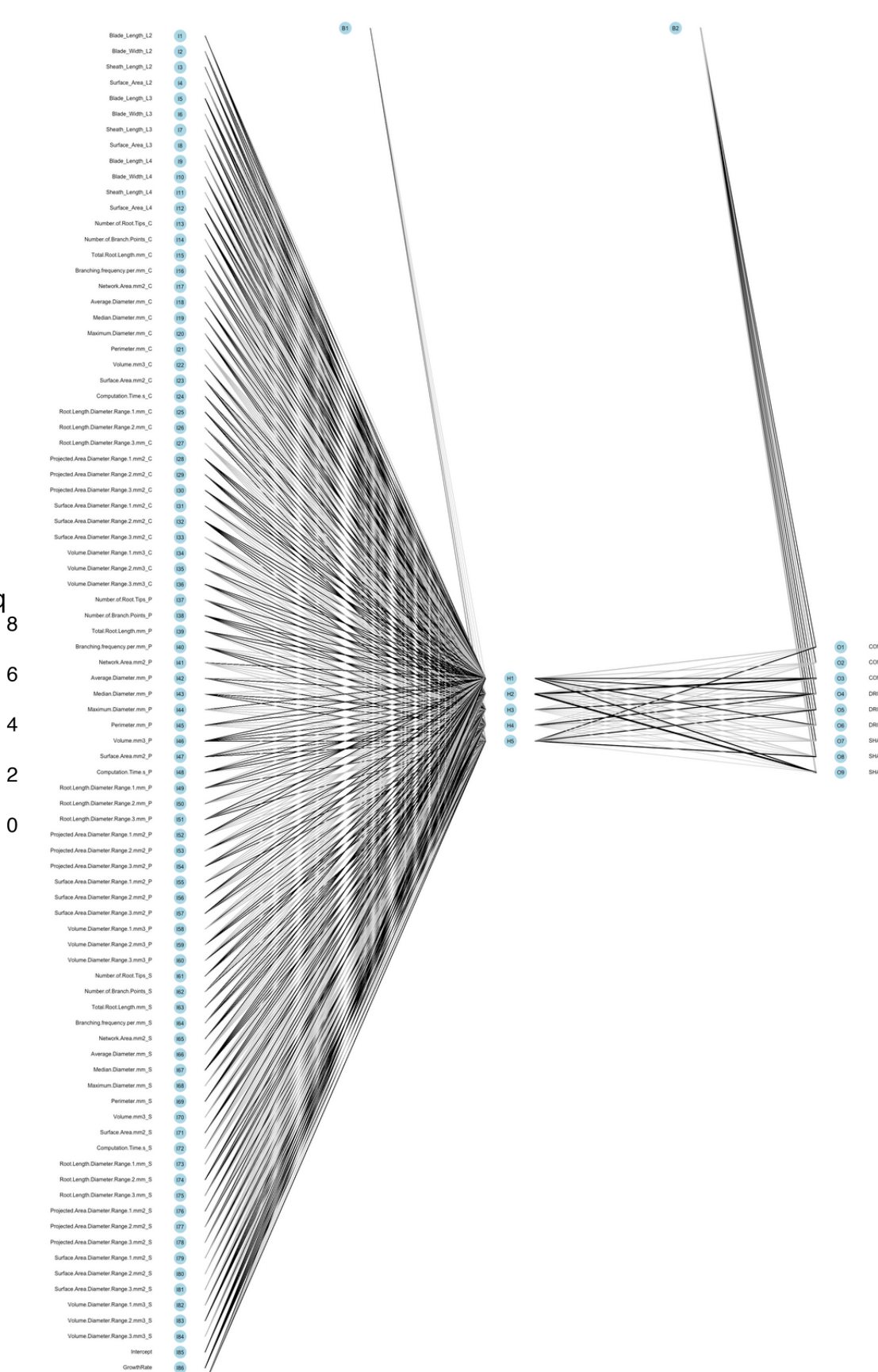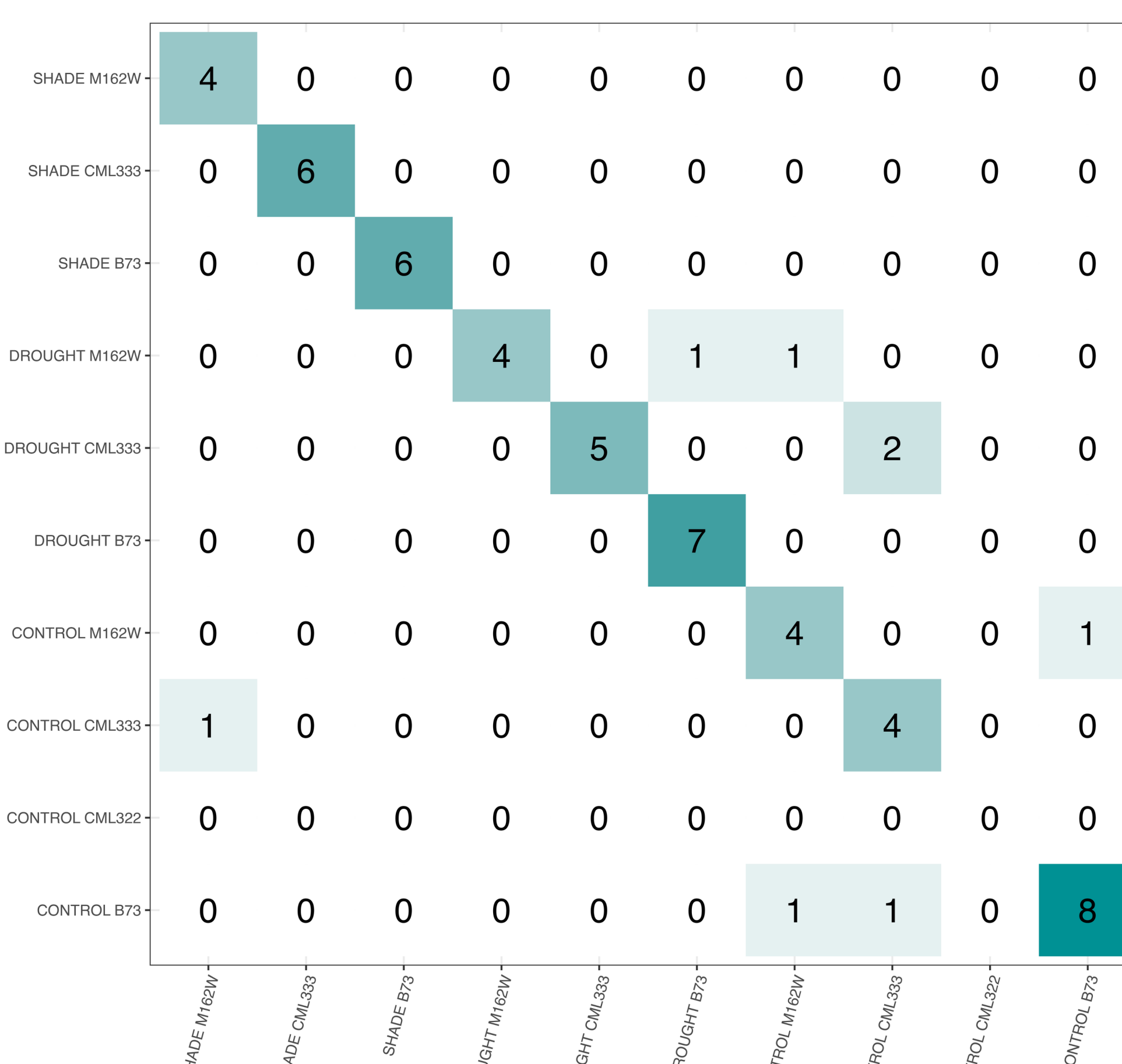
Shade — 100%
Control — 100%
Drought — 66.7%
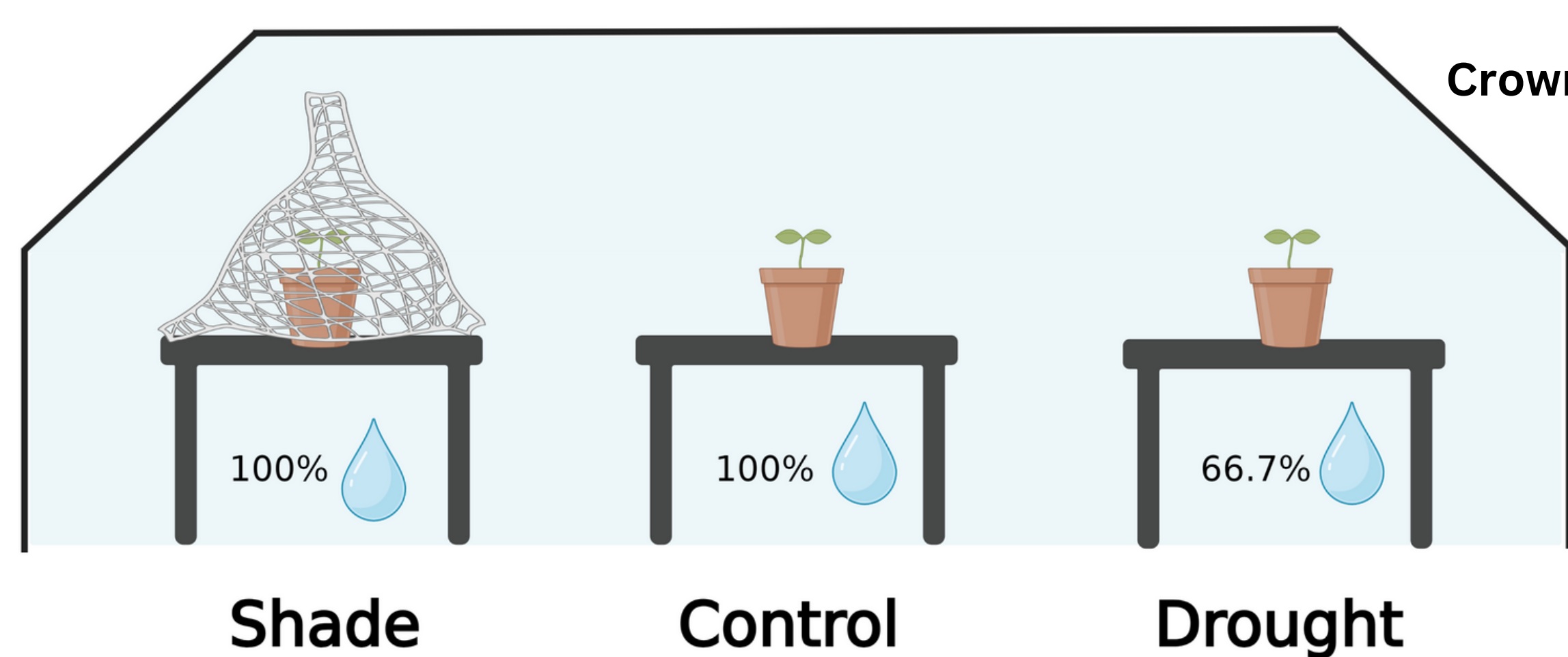
Malama i ka 'āina
to respect and care for the land
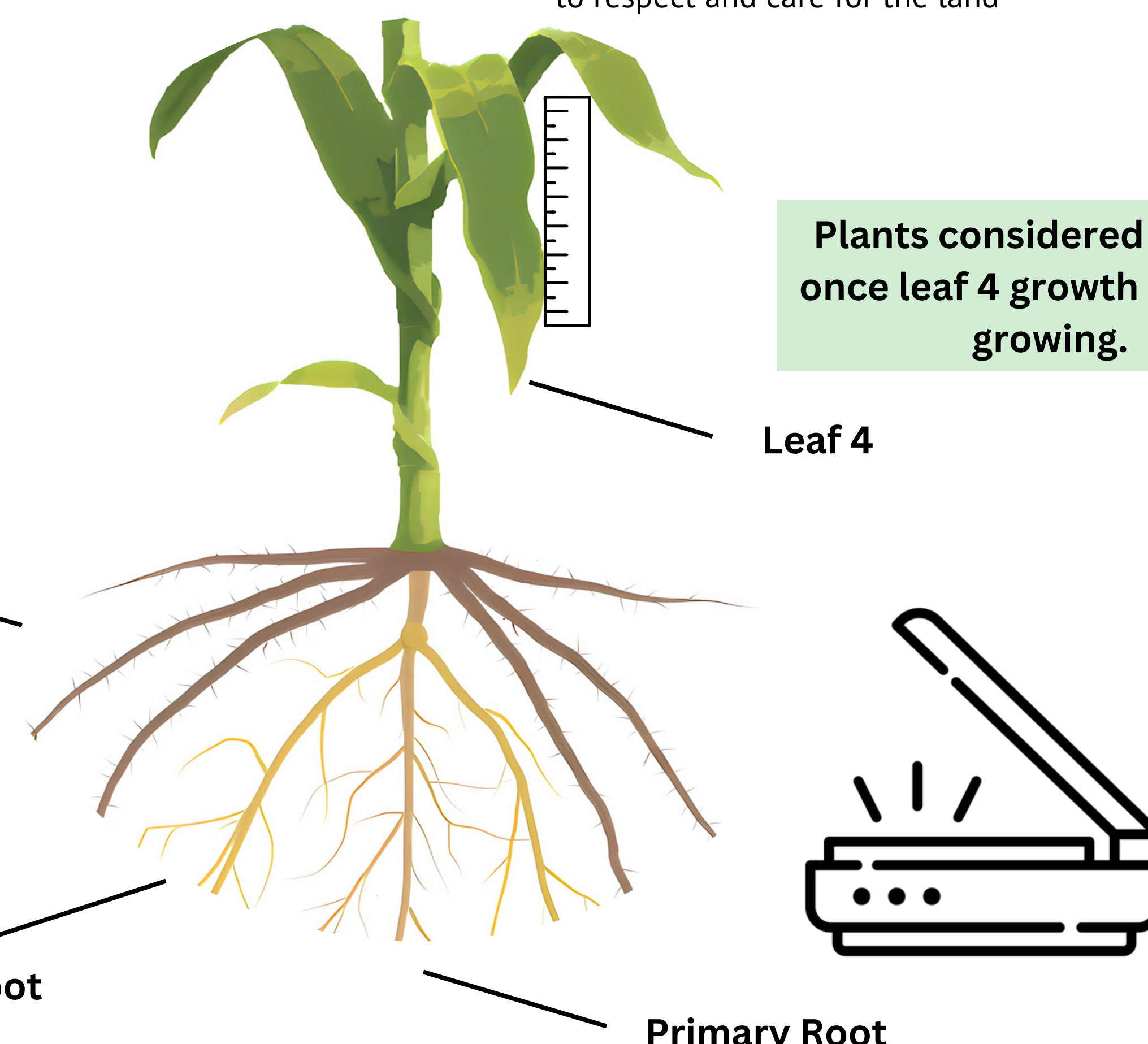
Leaf 4

Plants considered mature once leaf 4 growth stopped growing.

Crown Root

Seminal Root

Primary Root

All roots and leaves were scanned to determine mature characteristics.

Analyzing variance of shoot and root traits

Significance: 1
* Significance: 0.01
** Significance: 0.001
*** Significance: <0.001

Using ANOVA, there are significant differences in characteristics development in response to abiotic stressors.

Distributions of leaf 4 surface area across each genotype and treatment

B73
CML333
M162W

Treatment: Control, Drought, Shade

M162W is more resilient to abiotic stressors.

Shade Avoidance Response may cause greater leaf 4 surface area.

Regressions between leaf 4 surface area and length of each root type

Treatment: Control, Drought, Shade

B73 / CML333 / M162W

Abiotic stressors affect relationships of characteristics.

Growth rate in each genotype and treatment

2021 Summer Control, 2022 Fall Control, 2022 Summer Control, 2023 Spring Control
2023 Summer Control, 2023 Summer Drought, 2023 Summer Shade

Genotype: B73, B97, CML_277, CML103, CML228, CML247, CML322, CML333, CML52, CML69, HP301, Ky11, Ky21, M162W, M37W, Mo18W, Ms71, NC350, NC358, Oh43, Oh7B, Tx303, TziB

Growth rate differs between environments.

Characterizing based on shoot and root characteristics

	SHADE M162W	SHADE CML333	SHADE B73	DROUGHT M162W	DROUGHT CML333	DROUGHT B73	CONTROL M162W	CONTROL CML333	CONTROL CML322	CONTROL B73
SHADE M162W	4	0	0	0	0	0	0	0	0	0
SHADE CML333	0	6	0	0	0	0	0	0	0	0
SHADE B73	0	0	6	0	0	0	0	0	0	0
DROUGHT M162W	0	0	0	4	0	1	1	0	0	0
DROUGHT CML333	0	0	0	0	5	0	0	2	0	0
DROUGHT B73	0	0	0	0	0	7	0	0	0	0
CONTROL M162W	0	0	0	0	0	0	4	0	0	1
CONTROL CML333	1	0	0	0	0	0	0	4	0	0
CONTROL CML322	0	0	0	0	0	0	0	0	0	0
CONTROL B73	0	0	0	0	0	0	1	1	0	8

85.71% accuracy in model using 88 characteristics for treatment and genotype combination.

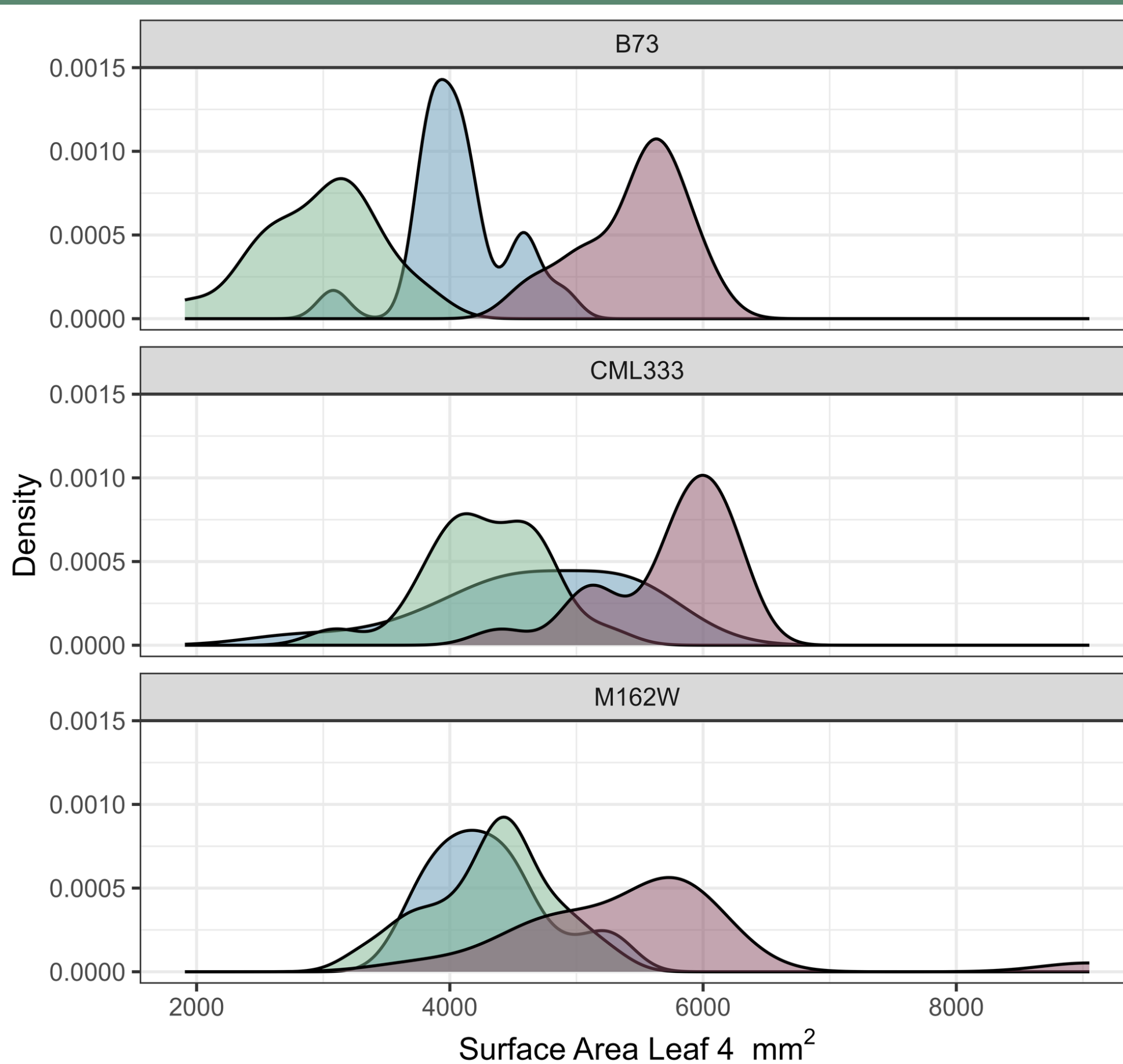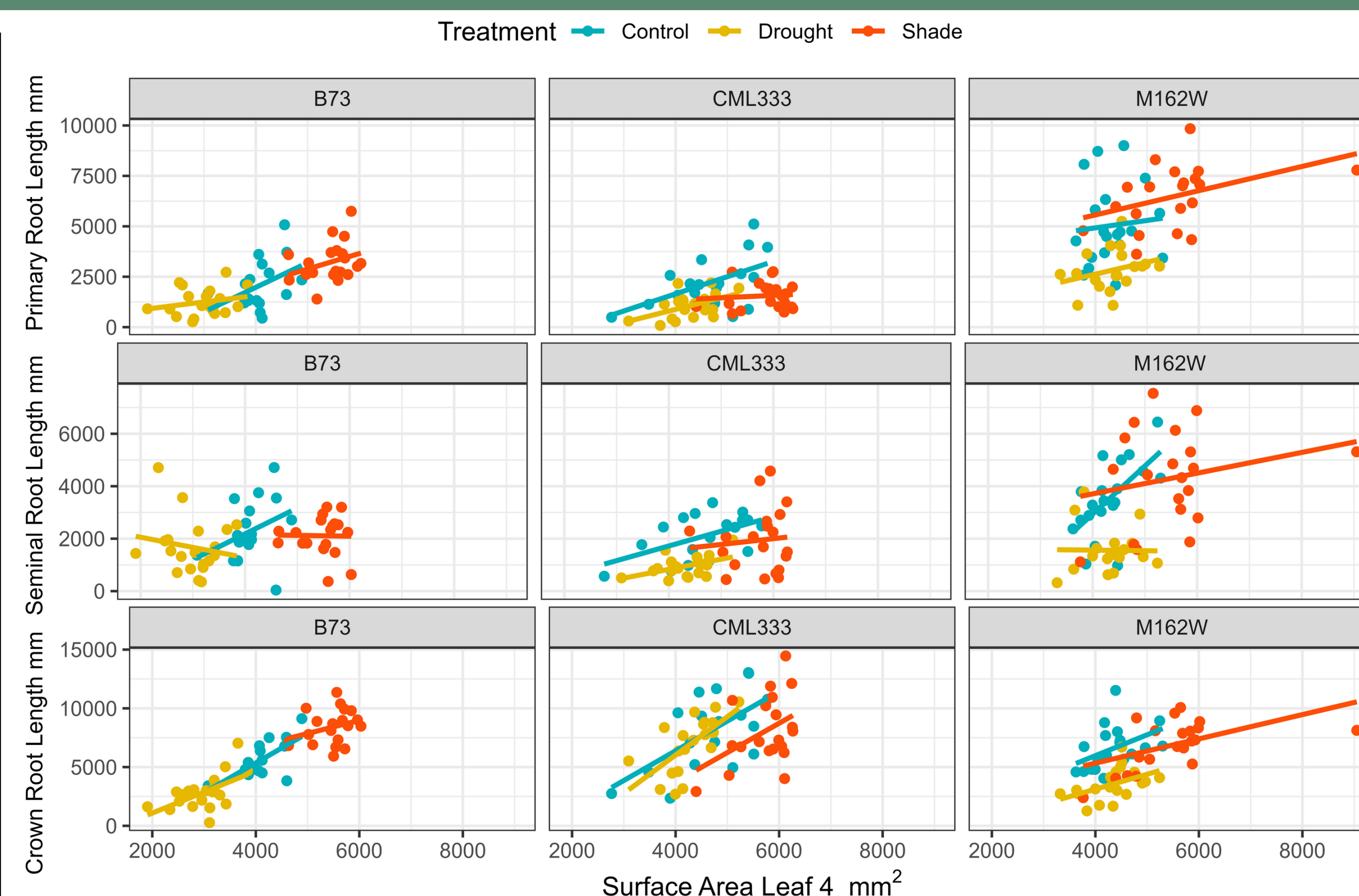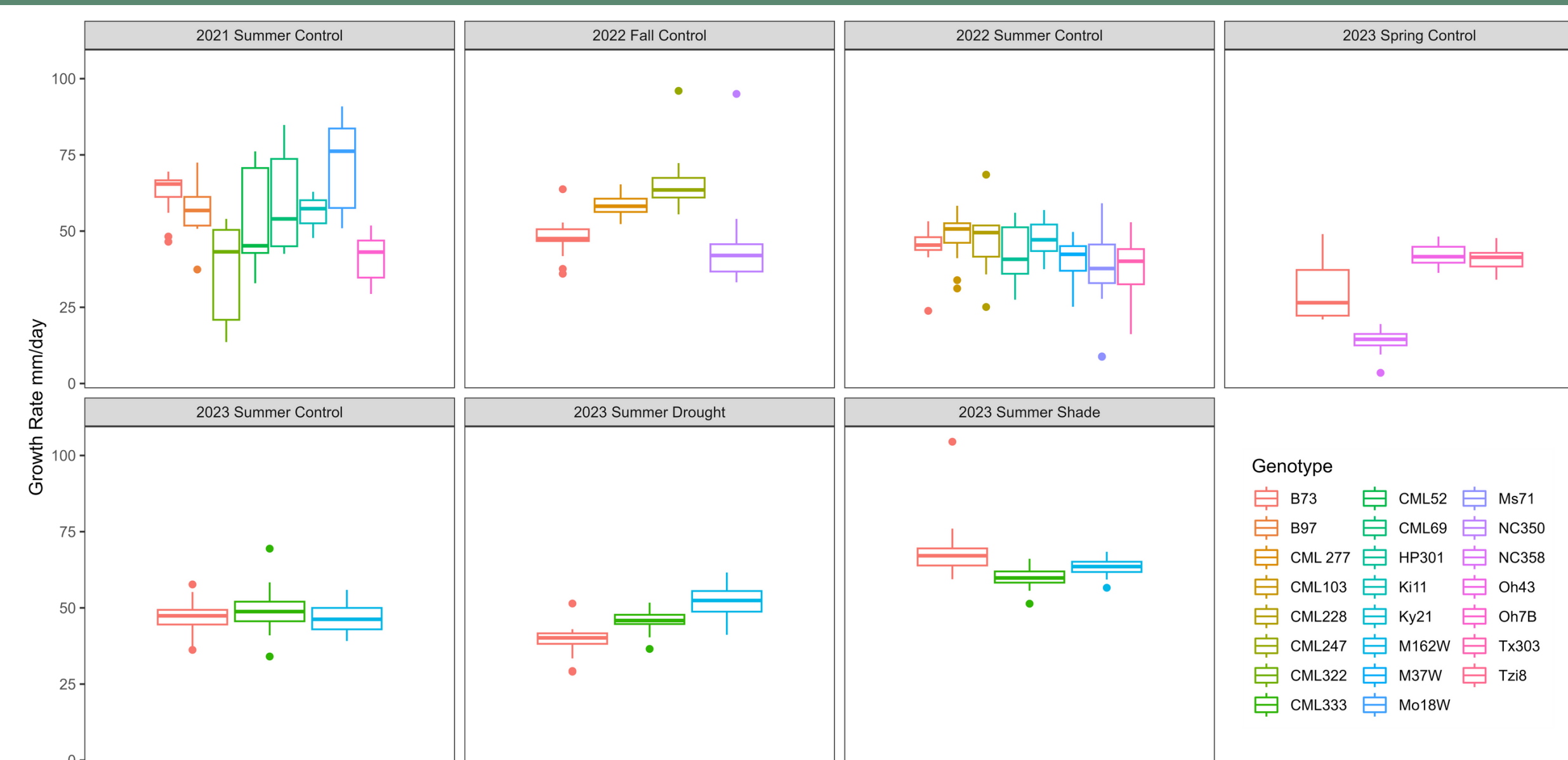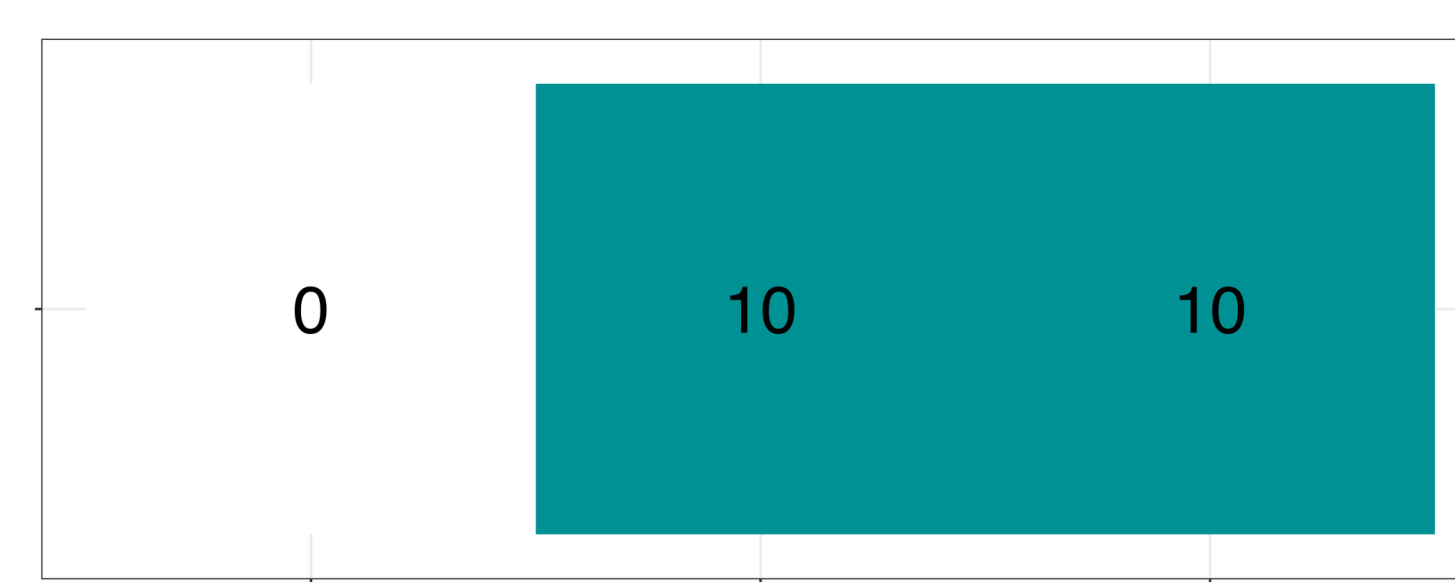Complexity of attributes differentiates genotype and treatment.

Determining environment of previous experiments

Summer 2021
14 | 1 | 2
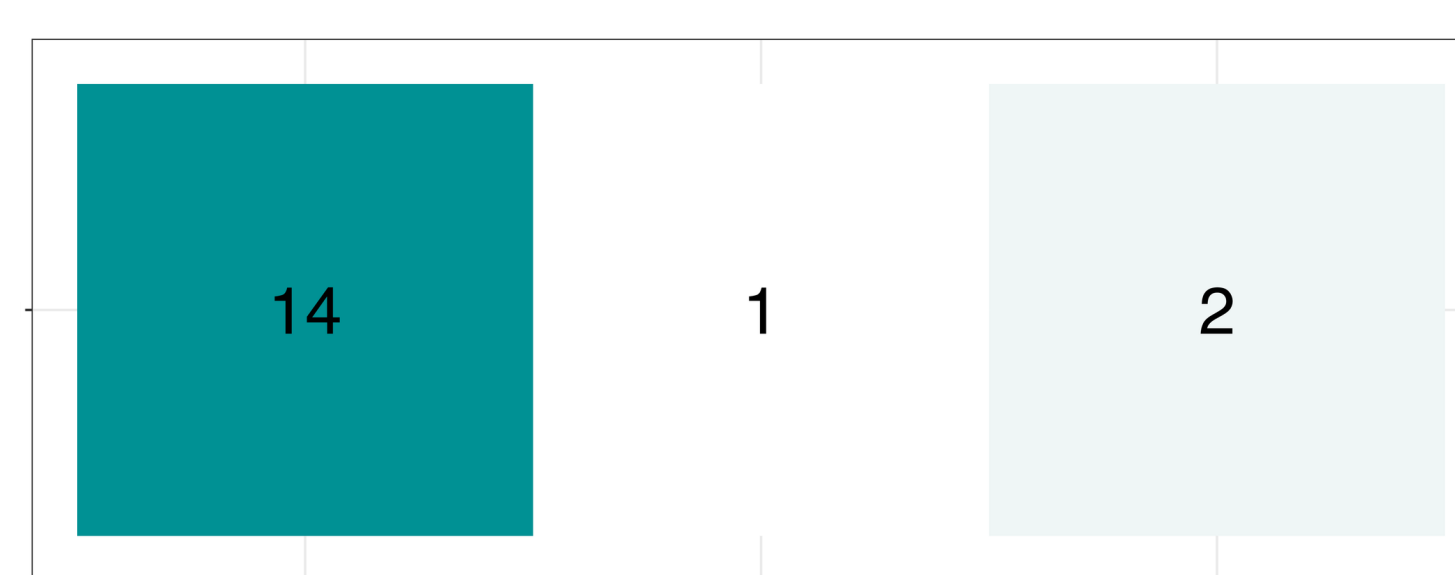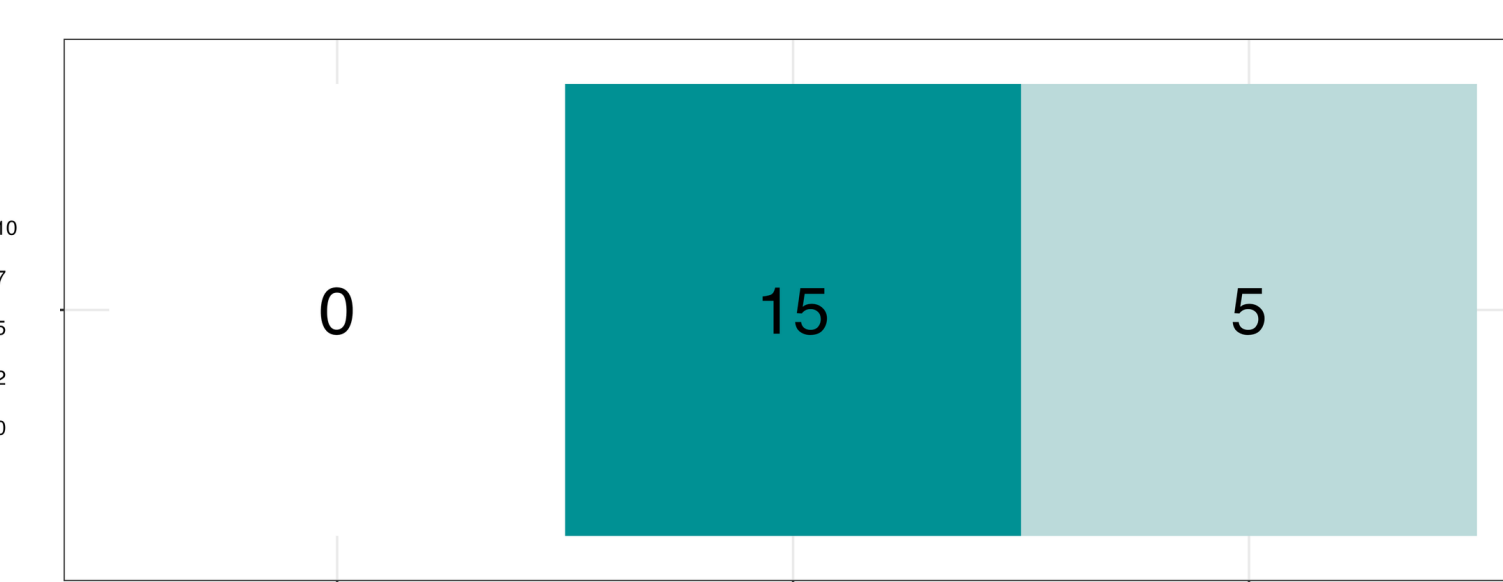
Environmental conditions of previous experiments based on 2023 Summer data of common B73 inbred line.

Fall 2022
0 | 10 | 10

Summer 2022
0 | 15 | 5

Why understand the relationships?

- Different abiotic stress are best understood when looking at both leaf & root characteristics
- Climate differs greatly across the different island In Hawai'i, determining how plants react to ongoing effects of climate change helps to plan for more resilient use of land.

Acknowledgements