

Purpose of Study

1. To characterize the response of wax begonia varieties to heat and light stress.
2. Determine if there is any variation in the response that leads to enhanced thermotolerance and light tolerance.



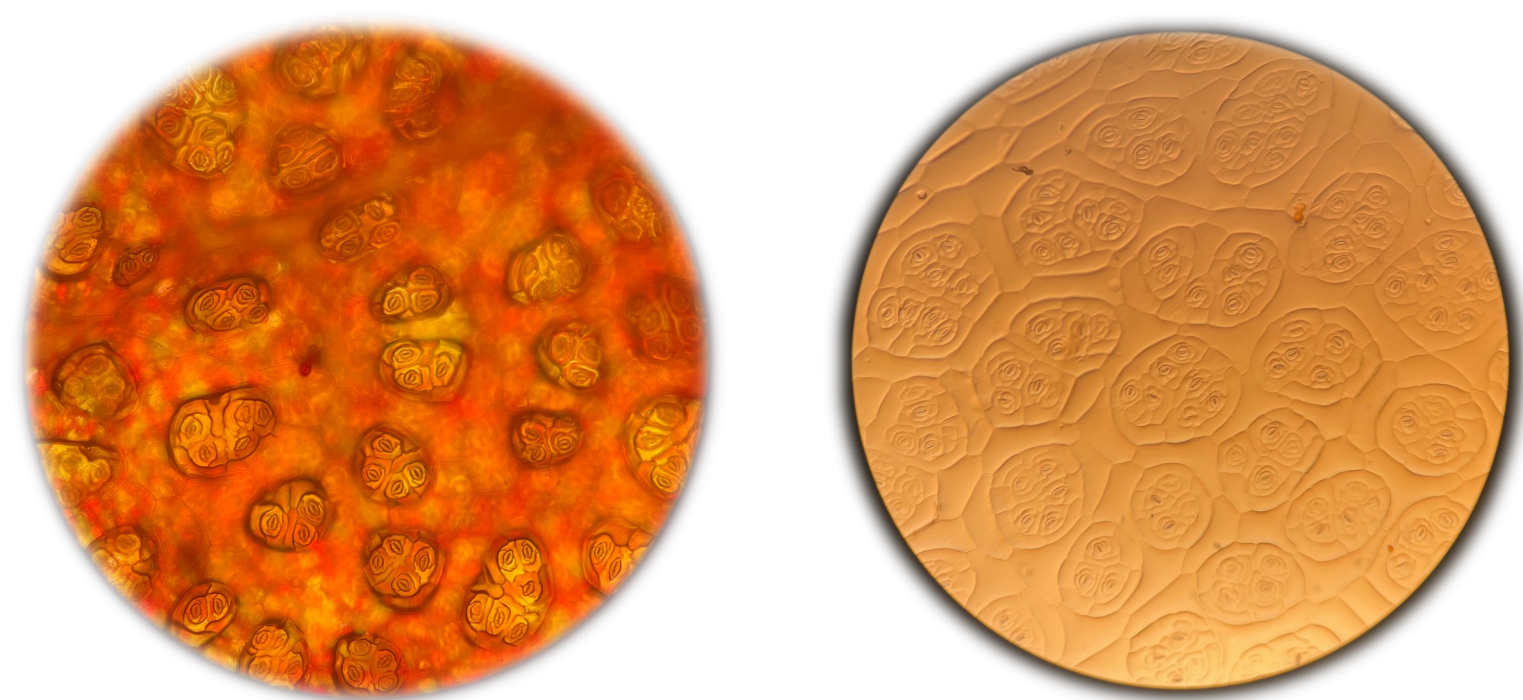
Design

- Four genotypes of wax begonia
FB059
Cocktail Vodka (CR)
Sprint White (CG)
Hawaii (HI-4)
- Two Treatments
Unshaded- 2100 μmol m⁻² s⁻¹, 35/22.5 °C
Shaded- 750 μmol m⁻² s⁻¹, 30/22.5 °C

Uniform Morphological Responses

Stomatal Density (SD)

- Increase in SD when comparing shaded to unshaded.
- Stomatal cluster size remains unchanged



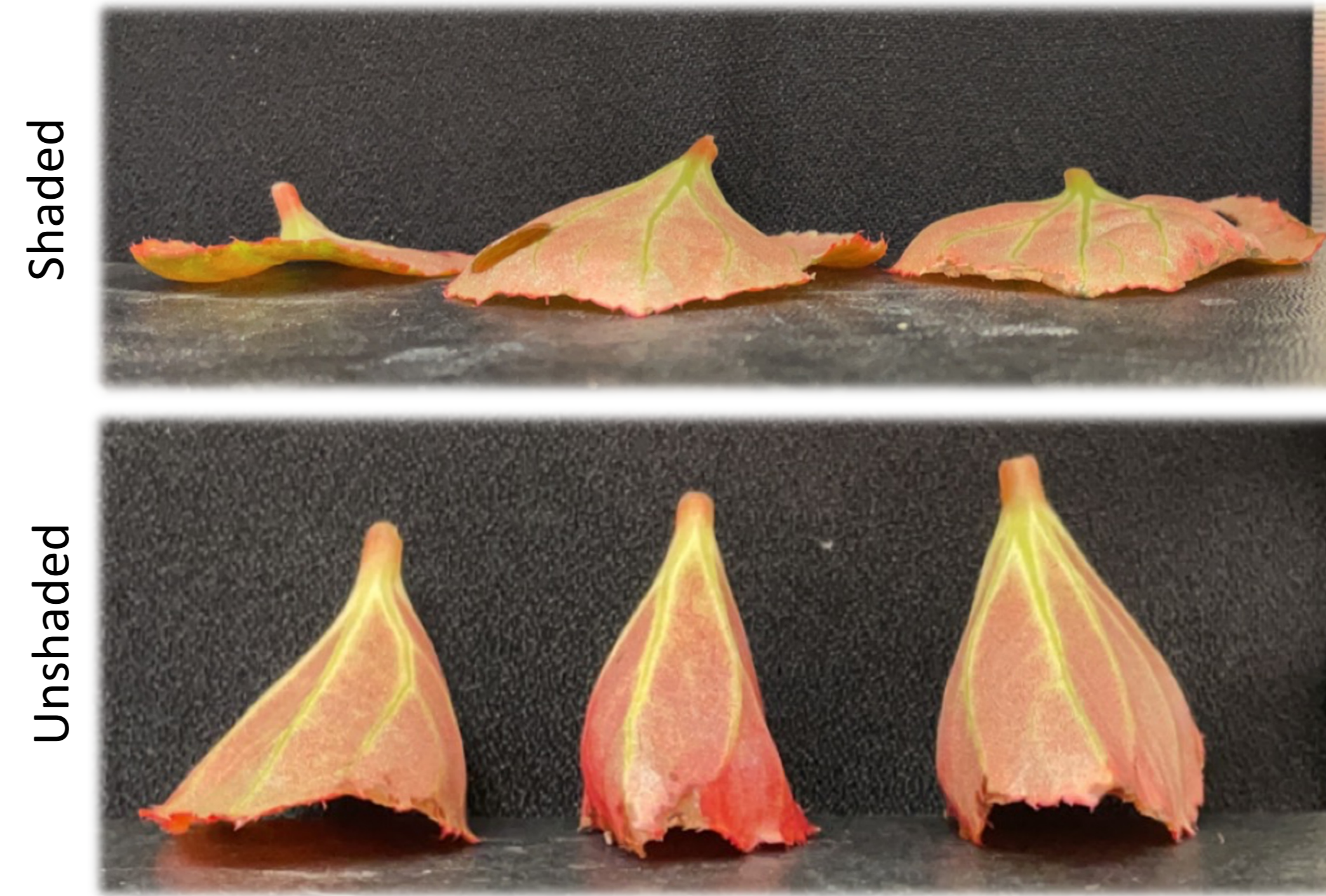
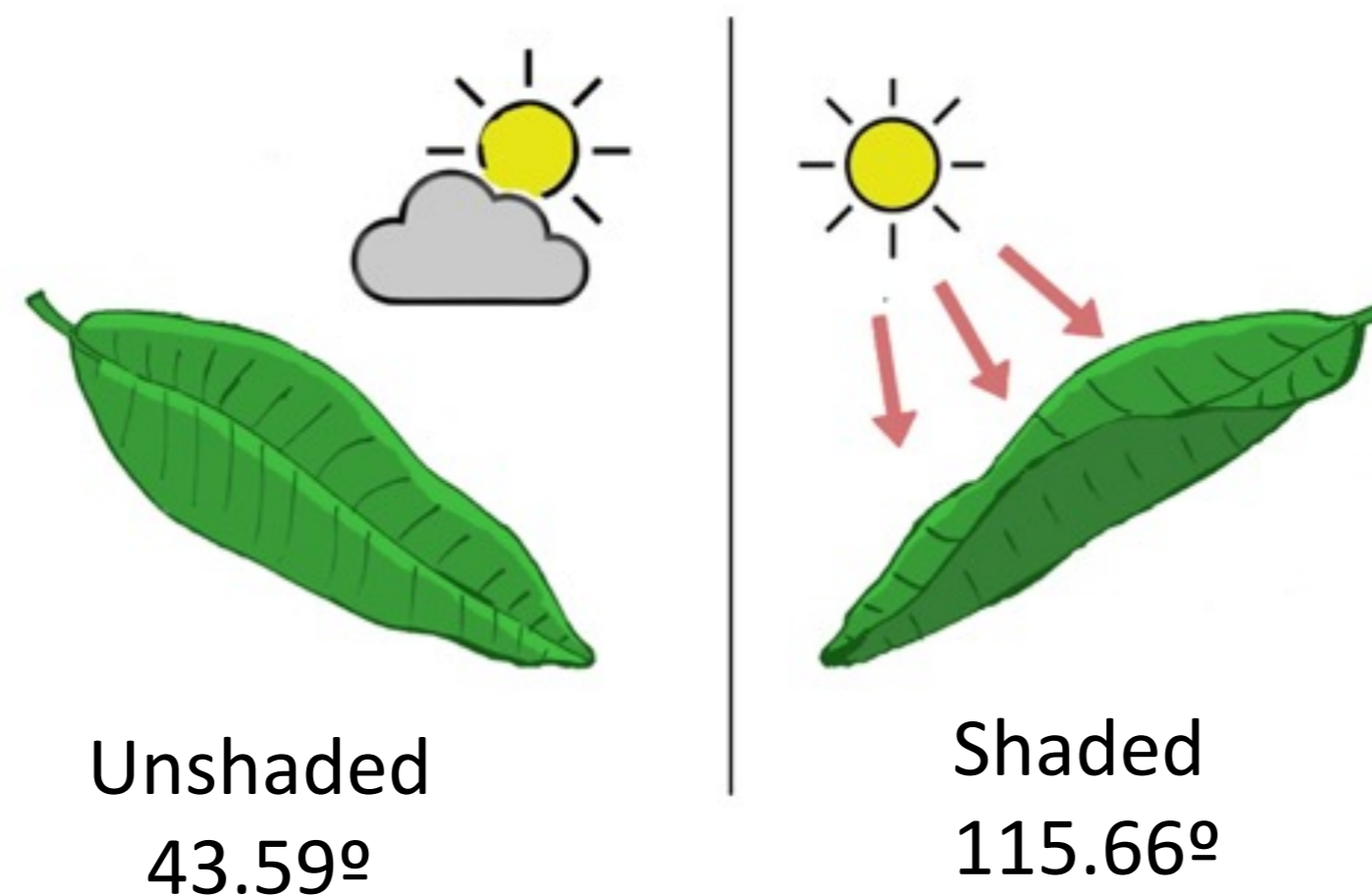
Note the stomatal clusters, unique to *Begonia* and few other plant genera.

Fresh/ Dry Weight

- No significant difference in response of each variety to heat and light stress.

Leaf Folding

| | Average Leaf Folding Angle | | |
|-------|----------------------------|--------|-----------------|
| | Unshaded | Shaded | Shaded-Unshaded |
| FB059 | 43.59 | 115.66 | 72.06 |
| CR | 62.41 | 124.31 | 61.90 |
| HI | 55.44 | 117.71 | 62.28 |
| CG | 105.31 | 142.26 | 36.95 |

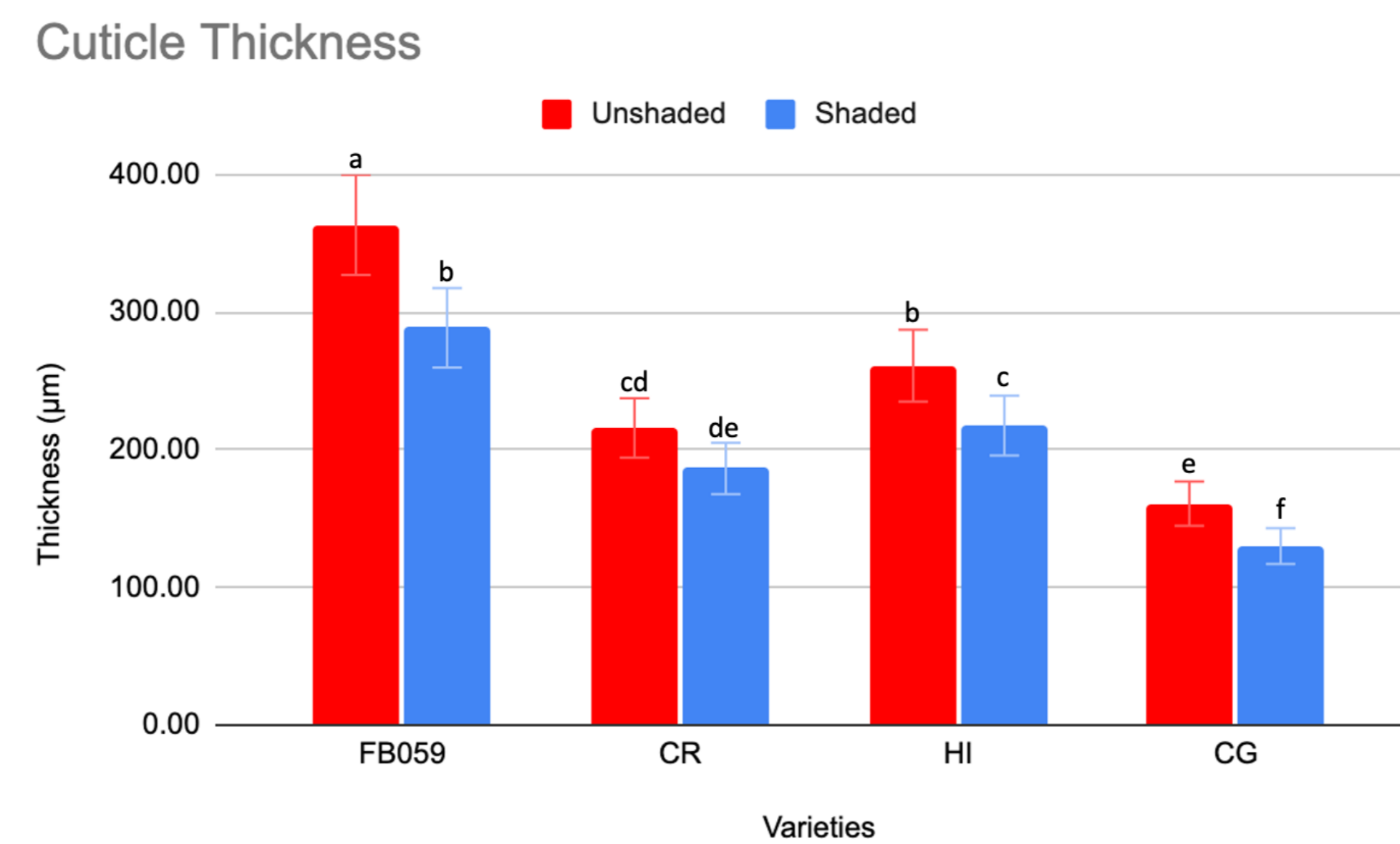


Leaf folding angle is one morphological traits that showed variation from genotype to genotype based on significance value from a 2-way ANOVA test and Tukey's HSD ($p \leq 0.05$). Leaves of FB059 folded inward to a mean angle of 43.59 in the full sun treatment compared to 115.66 in the shaded treatment.

Leaf Cuticle Thickness

| | Cuticle Thickness | | |
|-------|-------------------|-----------|-----------------|
| | Unshaded | Shaded | Unshaded-Shaded |
| FB059 | 363.33 a | 288.61 b | 74.72 |
| CR | 215.83 cd | 186.39 de | 29.44 |
| HI | 261.11 b | 217.58 c | 43.54 |
| CG | 160.83 e | 130.00 f | 30.83 |

| | Cuticle/Total Leaf Ratio | |
|-------|--------------------------|--------|
| | Unshaded | Shaded |
| FB059 | 0.61 | 0.54 |
| CR | 0.46 | 0.43 |
| HI | 0.50 | 0.47 |
| CG | 0.43 | 0.42 |



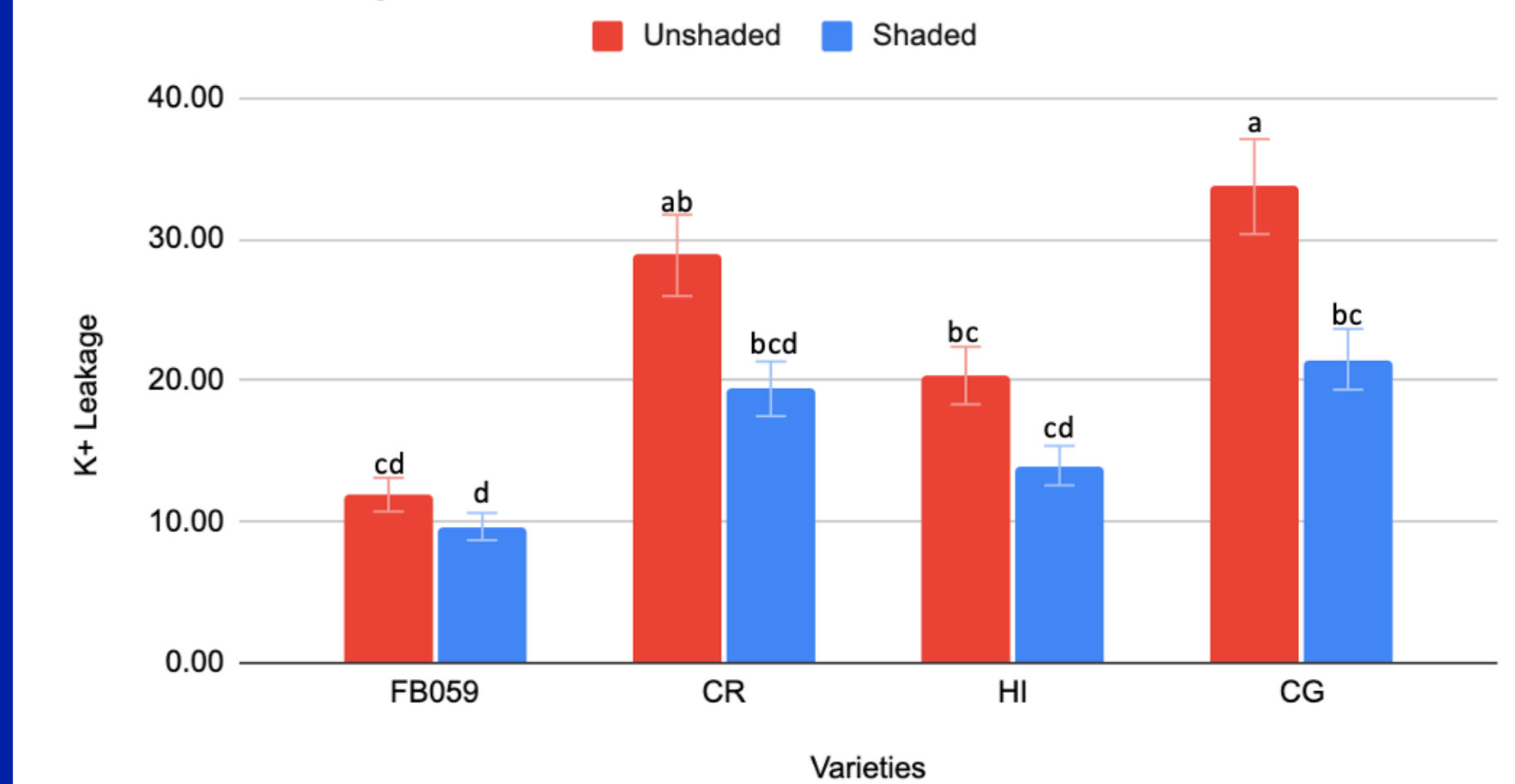
Leaf cuticle thickness was the second morphological trait that displayed varying response based on genotype. FB059 and HI-4 displayed a significant increase in cuticle thickness (2-way ANOVA, Tukey's HSD, $p \leq 0.05$). CG did as well but had the thinnest cuticle layer of all four genotypes. The cuticle thickness of new FB059 leaves produced in the unshaded treatment were 74.72 μm thicker than the shaded treatment and accounted for 61% of total leaf thickness.



How do we know these morphological traits enhance tolerance?

Less K⁺ Leakage = Less Stress!

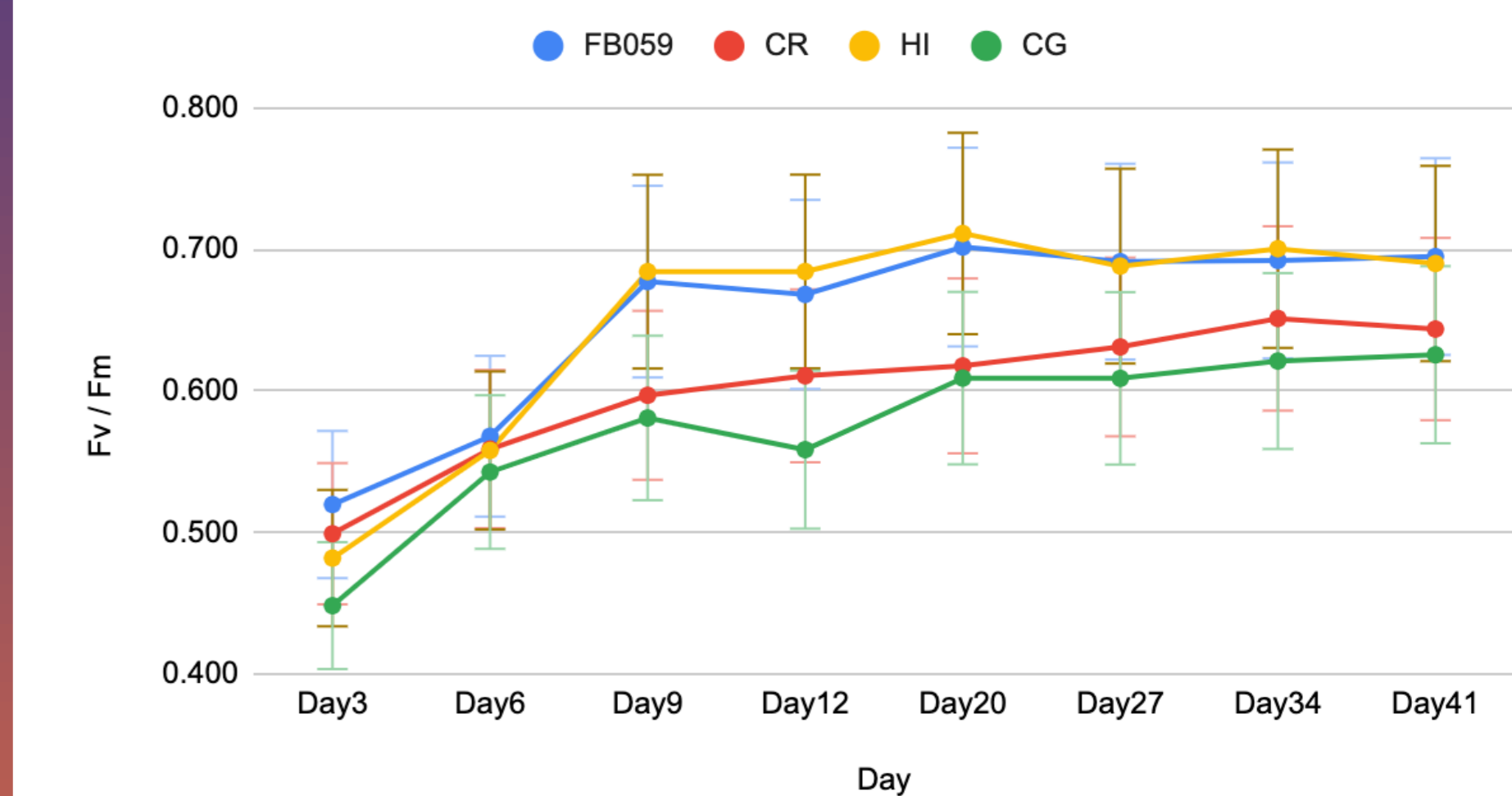
Ion Leakage



K⁺ leakage is a common parameter that quantifies the K⁺ ions that leak out of cells due to damage to the cellular membrane. FB059 displayed significantly lower levels of leakage in both the shaded and unshaded treatments (2-way ANOVA, Tukey's HSD, $p \leq 0.05$).

Fv/Fm is another parameter used to measure stress. A Fv/Fm between 0.75-0.8 implies a plant is functioning at optimal performance. There is no significant difference in Fv/Fm among four varieties under the shaded treatment (2-way ANOVA). Under direct sunlight and heat, the effect of these stressors on Fv/Fm is much more prominent, resulting in a very low Fv/Fm at Day 3 of the treatment. However, the Fv/Fm in unshaded FB059 and HI-4 plants gradually recovered to a level comparable to the shaded plants after twenty days. Conversely, Fv/Fm remain a relatively low level (0.45 to 0.64) in CG and CR, suggesting that stress effect is more severe in both these varieties.

Fv/Fm Unshaded



Higher Fv/Fm = Less Stress!