Characterizing variation in root angle and stomatal density in *Phaseolus* interspecifics

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Basic characterization to support climate-ready breeding

Root angle and morphology

Frequency of stomata – greater transpiration

- Improve characterization of the hybrid complexes

Rooting Angle Characterization

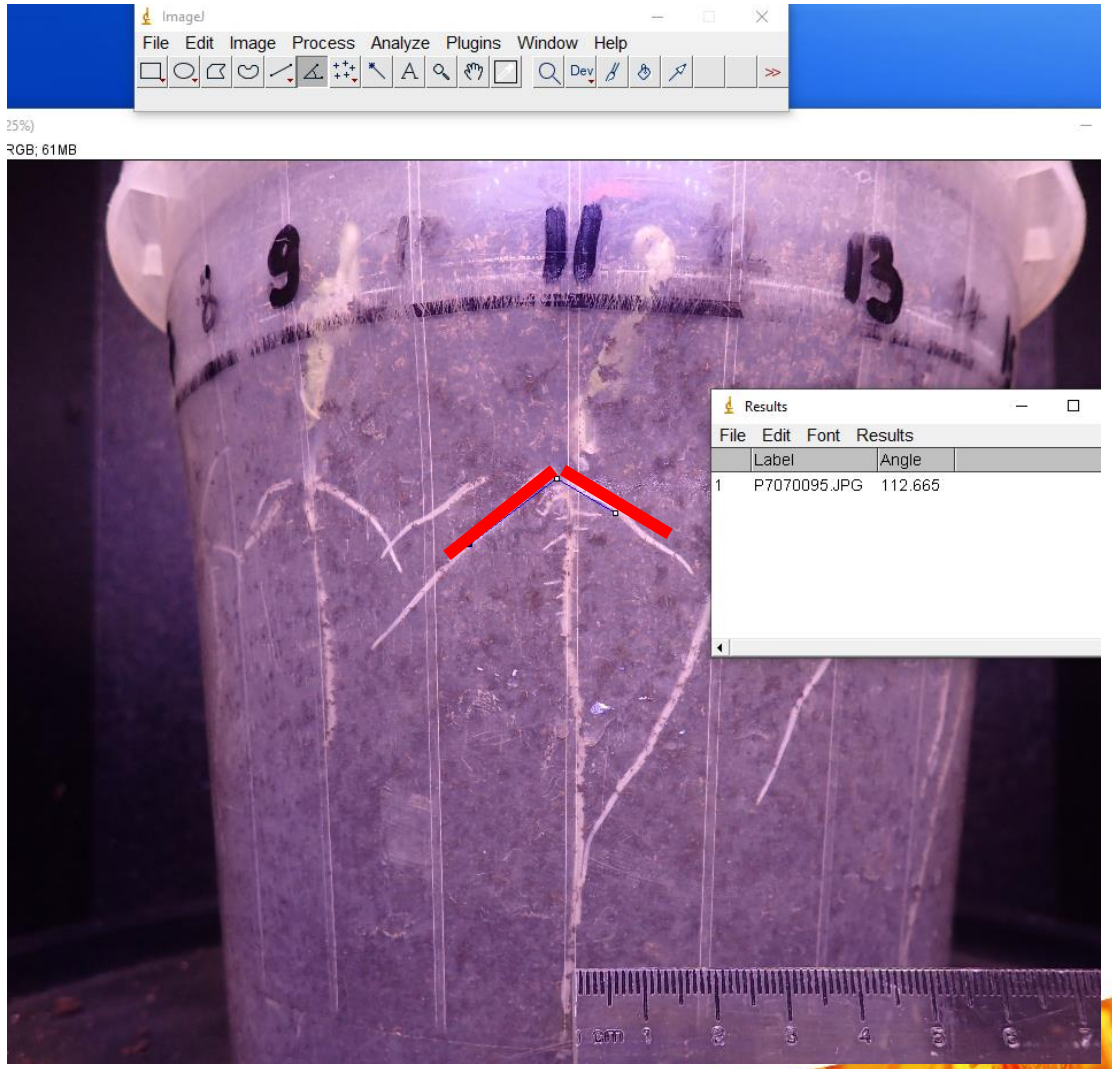
- Root phenotype can contribute towards fitness and resilience towards abiotic stress
- Assess angle of first seminal roots of bean hybrids

- Wider angles associated with drought resistance in wheat (Pinto & Reynolds, 2015)

- Root whorl number- greater number of basal root whorls increases phosphorus acquisition (Miguel M.A at all 2013)

Rooting Angle Characterization

- Transparent pots, randomized sowing
- Imaged approximately 7 days after sowing
- The angle between the first pair of seminal roots was measured using ImageJ software
- 30 seed per accession



G40001 parent
Phaseolus acutifolius, Mexico, Veracruz, Cordoba, Cultivated

Phaseolus acutifoilus (Case 10 Parent)

- Mesoamerican, Case 10 Parent line,
- Desert/semi-desert, >30°C day and >20°C night,
- Short flowering time, fast seed production
- Less investment in producing large root system
- Resistant to drought
- Wide root angle, shallow profile

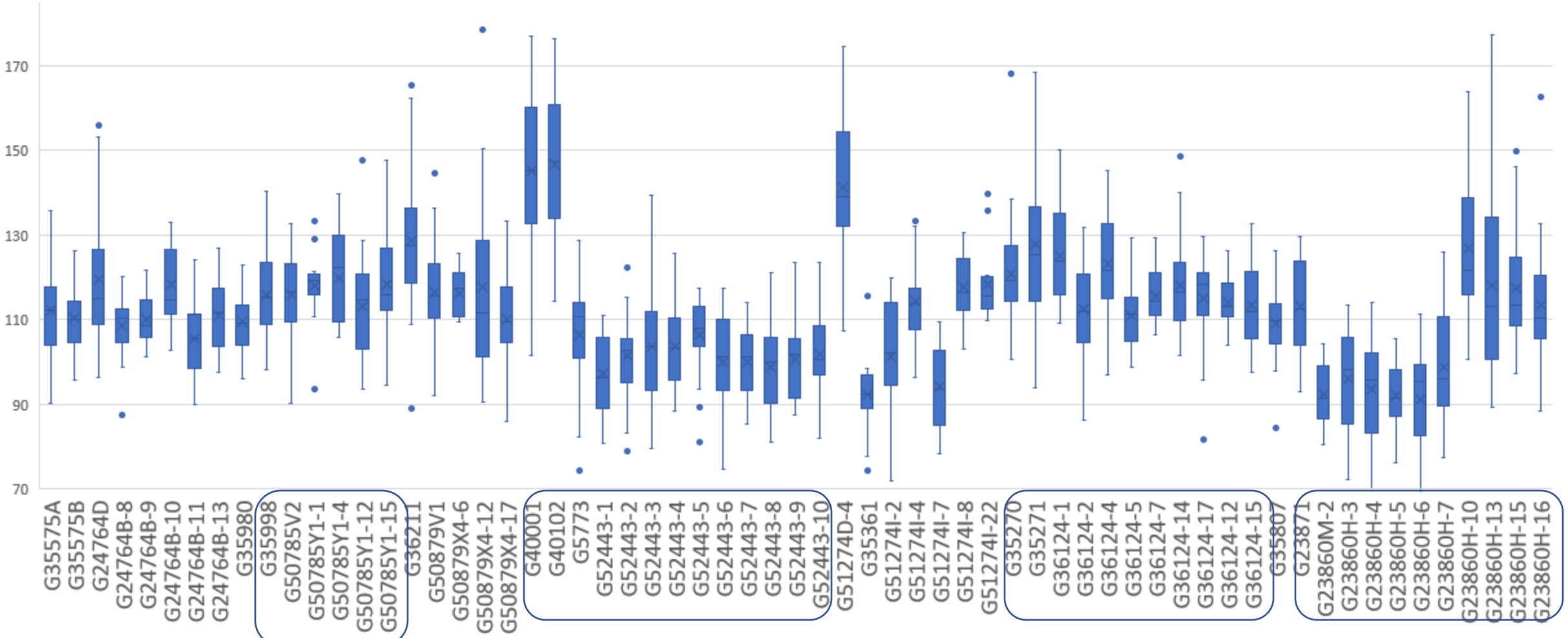
G35271 parent
Phaseolus coccineus, Colombia, Putumayo, San Francisco , cultivated

G35270 parent
Phaseolus dumosus, Colombia, Putumayo, San Francisco cultivated

Phaseolus coccineus, Phaseolus dumosus (Complex 14)

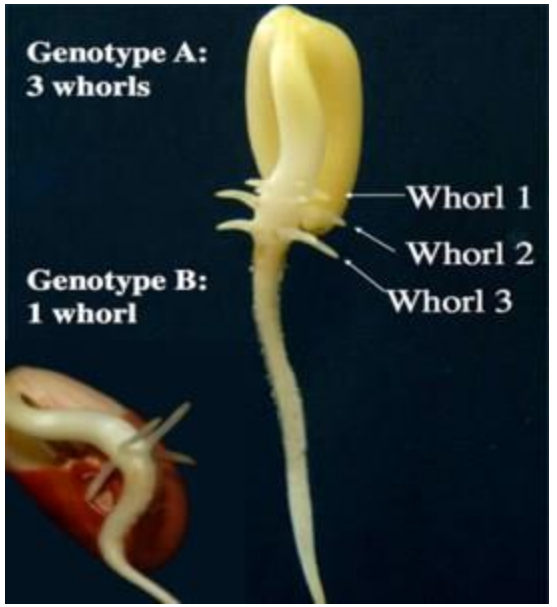
- Andean, mountain forest habitat, shade, humidity
- 12-22 °C day, 12-14°C night (16-22°C, *P. dumosus)*
- Tall as 10m- (*P. dumosus*)
- Vigorous establishment, competitive
- Strong root system, low P foraging
- *P. coccineus* - short perennial vine 1-2 years
- *P. dumosus* - 4-6 years growth, polycarpic plant
- Low light requirements
- Tuberous root system which allows them to regrow

Range of root angles observed in hybrid accessions

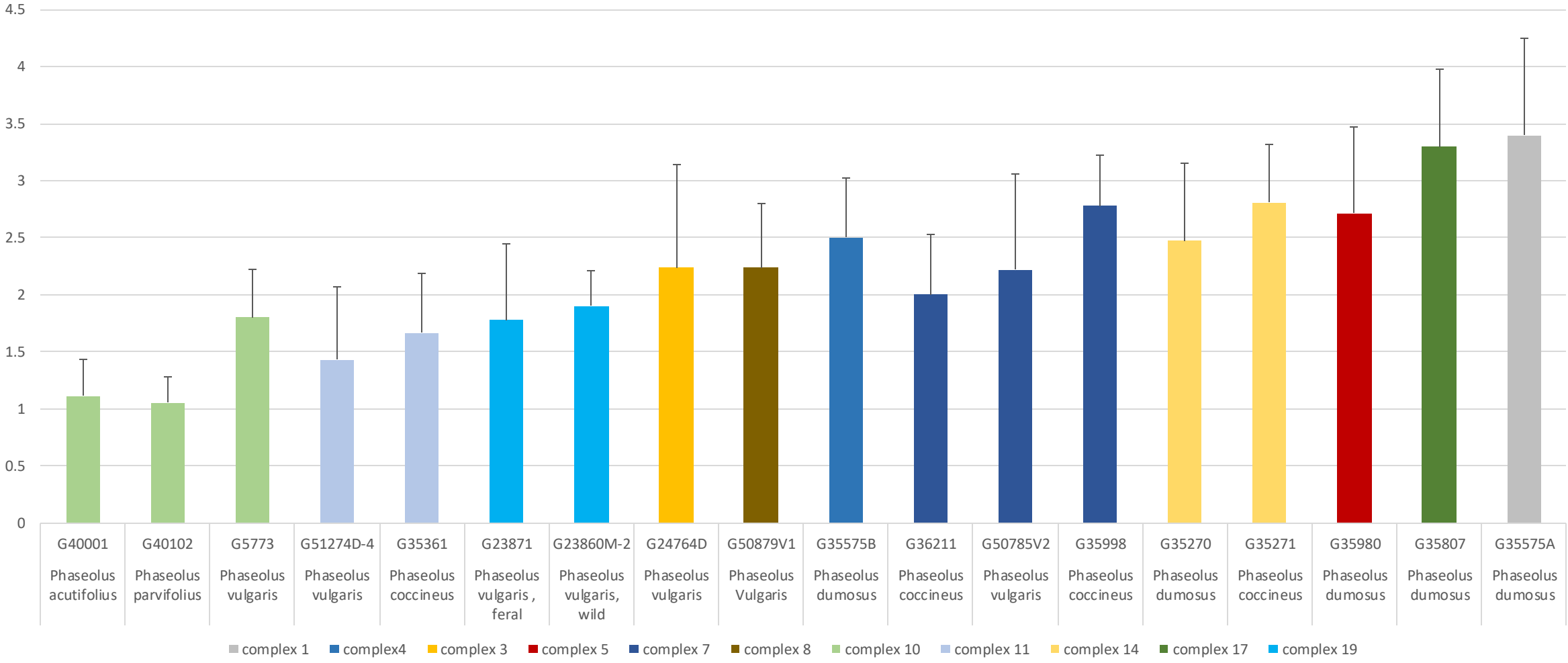


Basal root whorl number

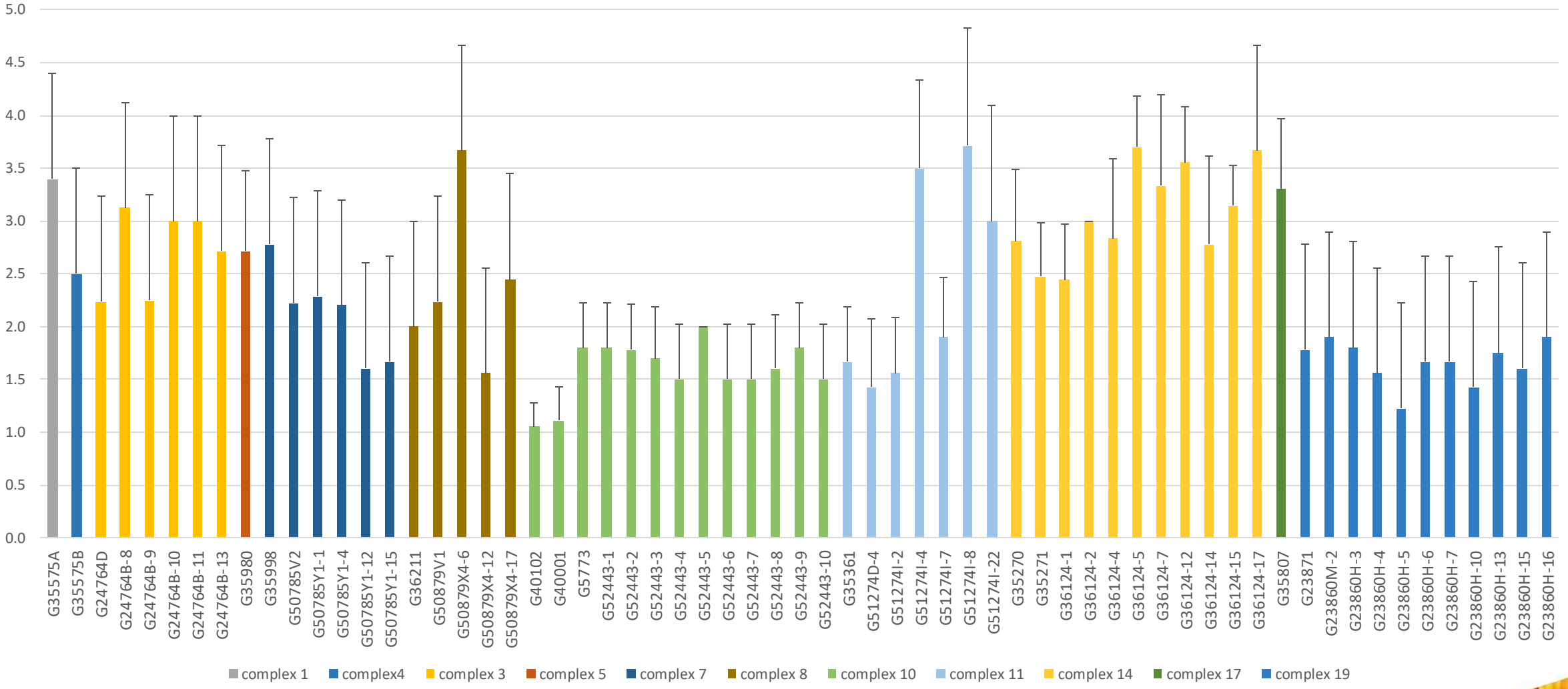
- Large areas of tropical and subtropical areas in Africa, Latin America and Asia, have limited availability of phosphorus (Vance at al. 2003)
- Greater basal root whorl number is associated with increased phosphorus acquisition (Miguel M.A at all 2013)
- Shallow root angle and increased basal root number increase topsoil foraging



Basal root whorl number parental accessions



Average basal root whorl number



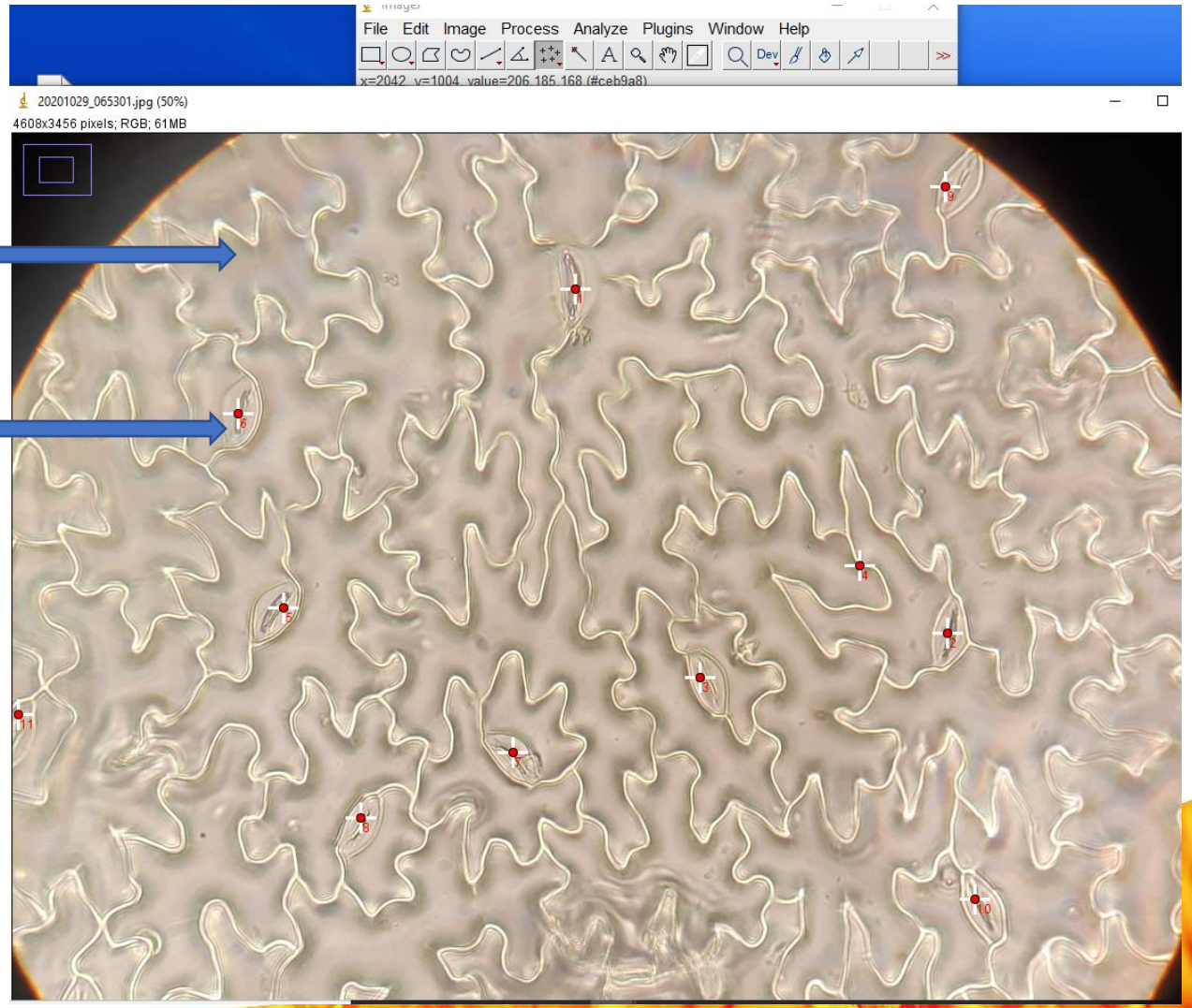
Assessing for diversity in the number of stomata

- Stomata plays a critical role in photosynthesis and nutrient uptake by regulating gas exchange and transpiration. Production of stomata is highly plastic.
- Environmental factors such as light intensity, temperature and drought influence stomatal development (Han at al 2021)
- Leaf cooling, increased number of stomata in higher temperatures can lead to greater transpiration and hence water-loss in rice (Crawford R.S at all 2018)
- Decreased stomatal index, increased drought tolerance and water conservation (Crawford R.S at all 2018, Han at all 2021)
- High temperature supresses stomatal development

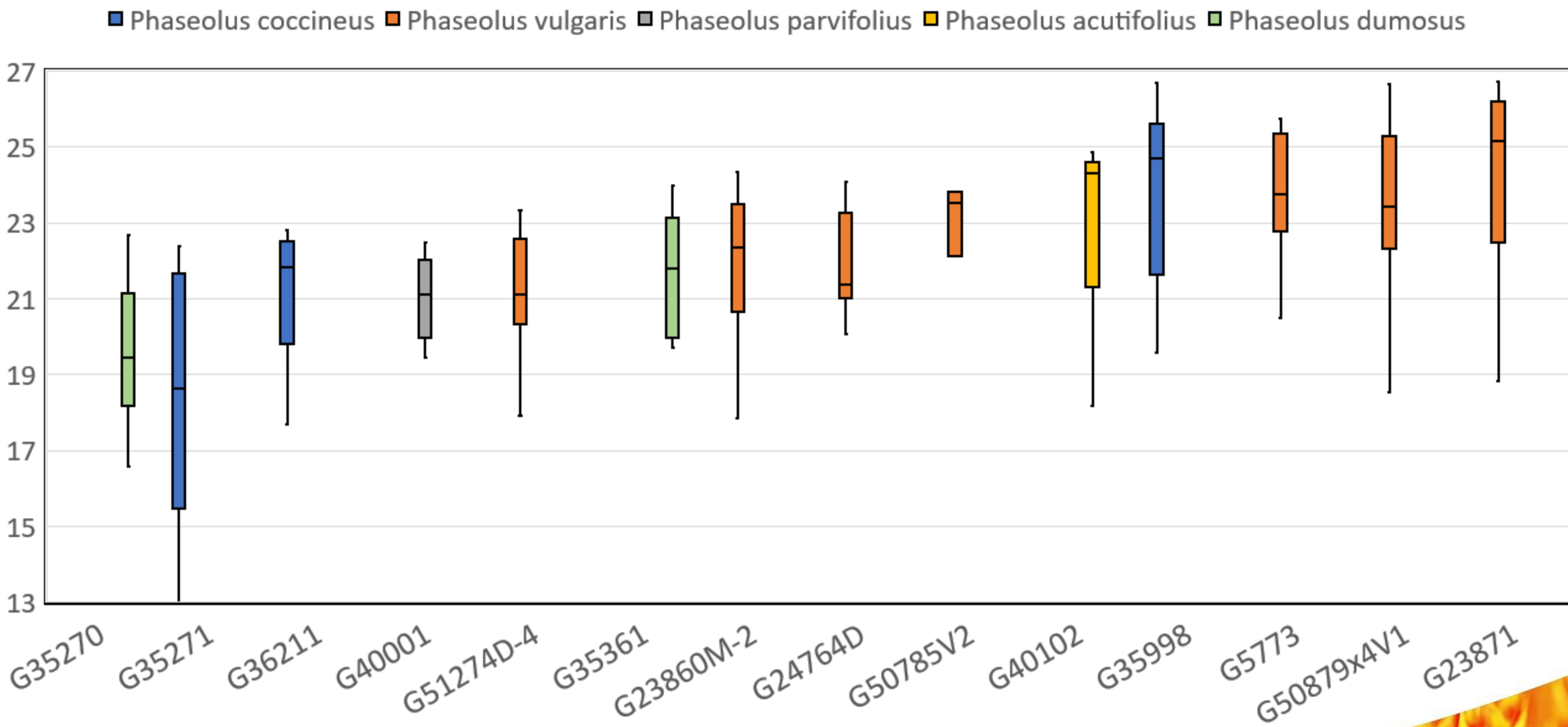
Assessing for diversity in the number of stomata

- 10 leaves per plant
- Abaxial imprint (nail-gloss and tape)
- Photographed 40 x
- Count cells in five random areas
- Converted in stomatal index

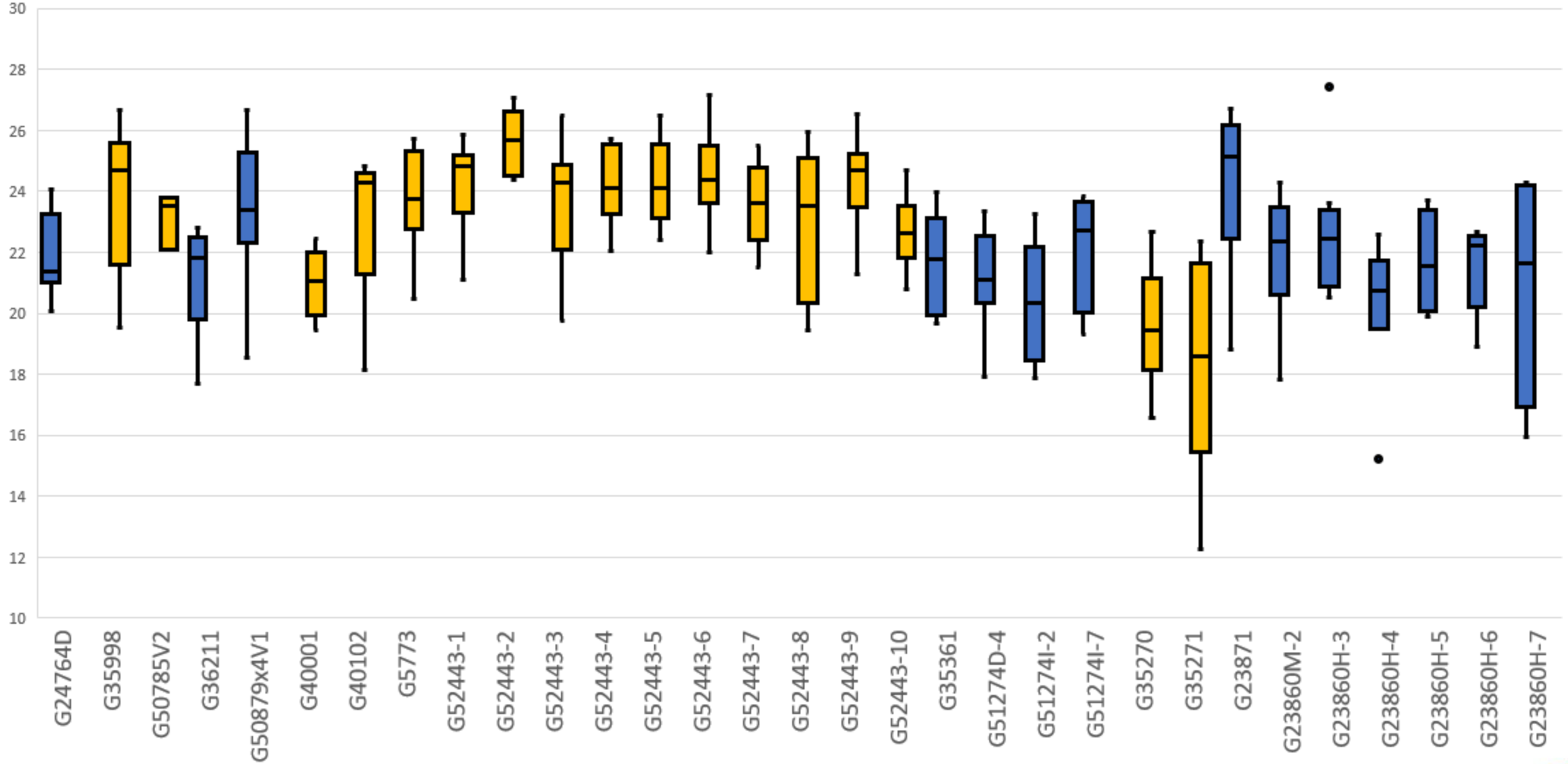
No. Stomata x 100/(No. epidermal + no. stomata)



Average stomatal index parental lines



Average stomatal index



Questions?