Using *Arabidopsis thaliana* Ecotypes to Investigate the Role of PSAE-I in Vegetative Phase Change

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Abstract

During vegetative phase change, plants transition from juvenile to adult vegetative growth. In *Arabidopsis thaliana*, vegetative phase change is signified by an increase in abaxial trichomes and a decrease in leaf angle. This transition is mediated by the microRNA miR156 and its targets in SQUAMOSA PROMOTER BINDING PROTEIN-LIKE (SBP/SPL) transcription factors. As a plant ages, a decrease in the expression of miR156 allows for an increase in SPL gene expression. The cause of the temporal change in miR156 is unknown. We used natural accessions to discover new mechanisms of vegetative phase change. One candidate gene that may have a role in vegetative phase change is PSAE-1, a gene that encodes for subunit E of Photosystem I. Null mutations of PSAE-1 delay the timing of vegetative phase and SNPs in PSAE-I are associated with delayed timing of vegetative phase change. We measured the timing of vegetative phase change by the appearance of abaxial trichomes and found that trichomes appear significantly later in the natural accessions Galdo-1, Bur-0, and Cal-0 than in Col-0. We performed sequencing on various natural accessions of Arabidopsis thaliana to confirm the annotated SNPs. Sequencing determined that there is a pattern of SNPs in the Galdo-1, Bur-0, and Cal-0 which were not in Col-0, Xan-1, and Sha. In addition, we found novel deletions in the PSAE-I gene of Galdo-1, Bur-0, and Cal-0 which were not in Col-0, Xan-1, and Sha. This indicates that the SNPs and deletions in PSAE-I are associated with later vegetative phase change. Two out of three of the natural accessions had significantly lower Fv/Fm values than Col-0. This indicates that photosystem I might be less efficient in these accessions compared to Col-0. To discover more about the role of PSAE-I in vegetative phase change, we will do genetic analysis and RT-qPCR of PSAE-I and miR156 in this group of natural accessions.

Vegetative Phase Change is conserved throughout plants

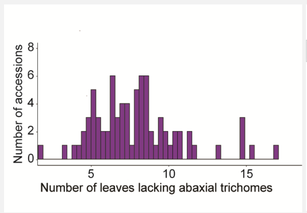
Arabidopsis thaliana

- Vegetative phase change is the transition from juvenile to adult vegetative growth that is often associated with changes in leaf morphology
- Abaxial trichome appearance is an indicator for vegetative phase change

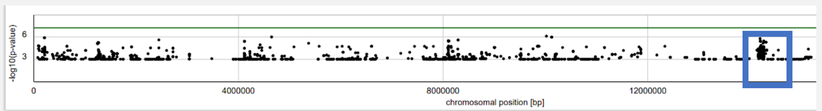
P. edulis

There is natural variation in the appearance of abaxial trichomes

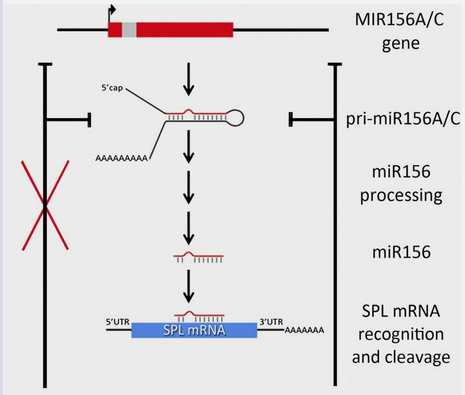
Geographical Distribution



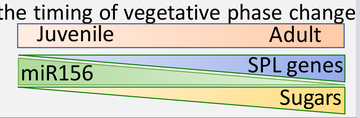
GWAS reveals a peak on chromosome 4



Vegetative phase change is regulated by miR156 and possibly sugars



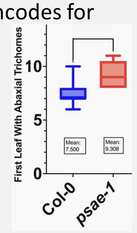
- miR156 is promotes juvenile traits by suppressing its target genes, SQUAMOSA-BINDING LIKE (SPL) transcription factors
- As the plant ages, miR156 expression declines, allowing for expression of the SPL genes
- Sugars may be a signal for the decline of miR156
- We want to determine if different photosynthesis efficiency (less sugars) partially explains natural variation in the timing of vegetative phase change

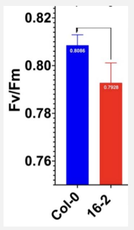


PSAE-I mutant has delayed vegetative phase change

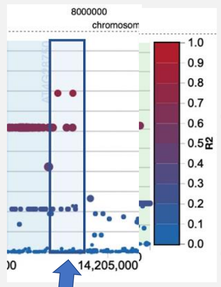
Psae-I has a null mutation in the PASE-I gene, which encodes for subunit E of photosystem I

- There are 3 phenotypes that I observed in *psae-I:*
- Delayed vegetative phase change
- Decreased photosynthetic efficiency
- Decreased size and pale green color

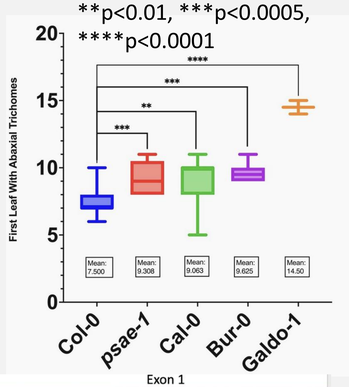


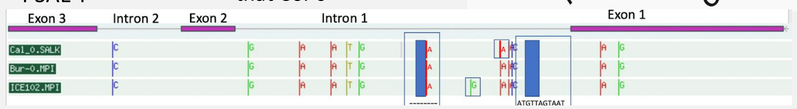


Natural Accessions with SNPs in PSAE-I have delayed vegetative phase change



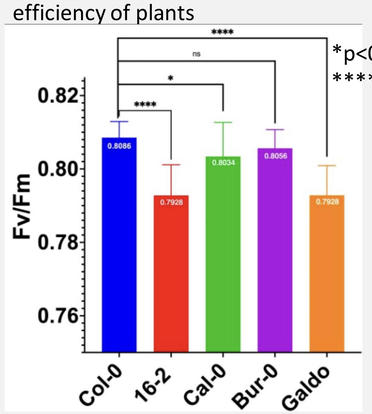
- There are 5 natural accessions that have SNPs correlated with delayed vegetative phase.
- We performed sequencing on 3 of the natural accessions. This confirmed the SNPs and found novel deletions.
- All of these accessions had later abaxial trichome appearance that Col-0



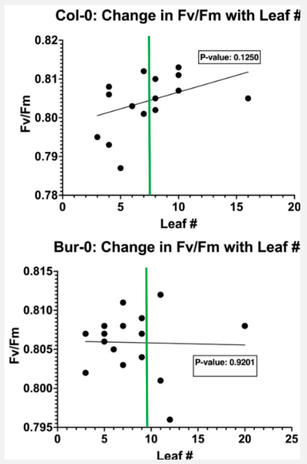


Ecotypes with SNPs have decreased Fv/Fm but this value does not vary with development

Fv/Fm is a measure of maximum quantum yield of PSII that indicates the photosynthetic efficiency of plants



*p<0.05,
****p<0.0001

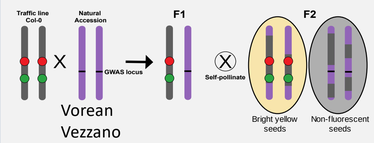


Conclusions

- Many of the SNPs and the novel deletions are in the first intron of PSAE-I
- There is evidence that the first intron in some Arabidopsis genes regulate gene expression
- Two of the three ecotypes with the SNPs have significantly lower Fv/Fm values
- This indicates the first intron may regulate the expression of PSAE-I

Next Steps

Crosses with Traffic Lines



Gene expression of PSAE-I

- Perform RT-qPCR
- We expected the ecotypes with SNPs to have lower expression of PSAE-I

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