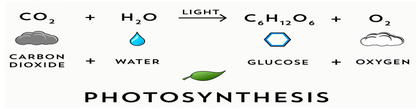
An Albino Mutant in *Brassica rapa* Maps to the *PDX2* Locus on Chromosome 10

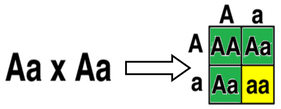
Cezar Sanchez, Beatriz Garcia, Nicholas Diaz, Ed Himelblau
Biological Sciences, Cal Poly, San Luis Obispo, CA 93407

Introduction:

We work to understand how genes control the growth and development of plants. *Brassica rapa* (turnip, Napa Cabbage) is a model system for plant biology. We have previously identified an albino mutant in *Brassica rapa*. This mutant is defective in the gene important for photosynthesis.



It has been established that the albino allele is recessive to wildtype. A 3:1 ratio of WT (Green) to albino is expected when heterozygous are crossed.

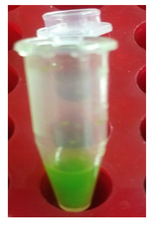
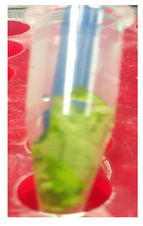


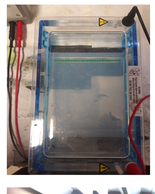
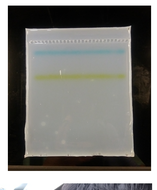
Prob. of aa = 1/4

Approach:

To map the albino mutation and determine the affected gene, we directly analyze the genotype of plants using molecular markers.

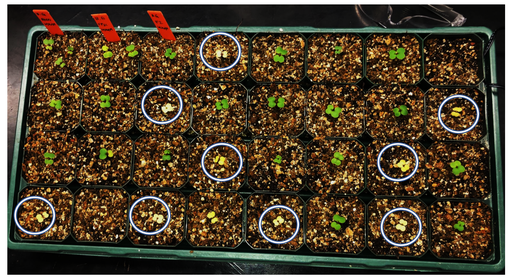
1. A segregating F2 population was grown (Figure1) and the ratio of WT to albino was determined.
2. For each plant, DNA was extracted.
3. DNA near the PDX2 gene was amplified using PCR.
4. DNA gel electrophoresis was used to determine if the genotype is heterozygous or homozygous.
5. The WT (green) plants in the F2 were self pollinated.
6. Progeny will be grown to confirm the parent's genotype.


Results:

F2 population showed a 3:1 ratio of wildtype:albino as expected for a traditional Mendelian trait. With a chi-square p-value of 0.2, it can be said that there was no significant difference between what was expected and what was observed in our data sets.

Albinos carry a single nucleotide mutation on chromosome 10 near the gene *PDX2* (a gene involved in vitamin B synthesis). This was confirmed by sequencing (below).

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WT   TTAGAAACTGCTTTAGAGTGT
Mut  TTAGAAACTGATTTAGAGTGT
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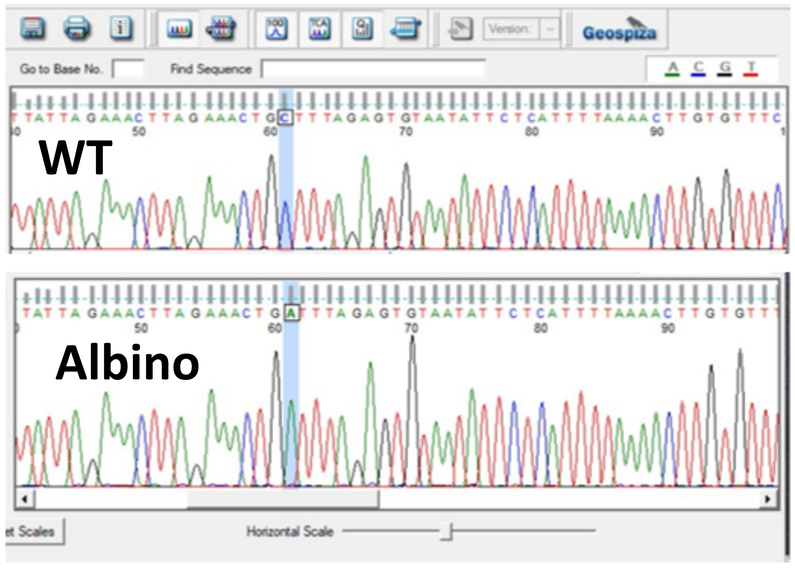
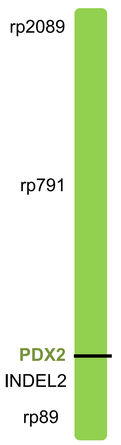


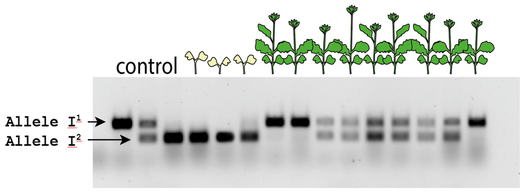
"The 2019 STEM Teacher and Researcher Program and this project have been made possible through support from Chevron ([http://www.chevron.com)/]www.chevron.com), the National Science Foundation through the Robert Noyce Program under Grant #1836335 and 1340110, the California State University Office of the Chancellor, and California Polytechnic State University in partnership with Cal Poly and [Any other organizations pertinent to your project]. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the funders."

Gene Mapping:



In gene mapping you try to make an *association* between a particular phenotype and a location on a chromosome. On the weather map (left) we don't know the exact weather in San Luis Obispo, but we see that it is likely to be raining because nearby locations where we have a weather report show rain. In genetic mapping you try to identify markers on the chromosome which are close enough to your gene that there is a perfect correlation between inheritance of the marker and inheritance of the phenotype.

DNA Analysis of INDEL2 Marker



Inheritance of the INDEL2 marker by albino and WT plants:

Detected Genotype	Albino phenotype	WT phenotype
I^2I^2	25	0
I^1I^2	0	37
I^1I^1	0	20

Conclusions:

- Confirmed that the albino mutation segregates as a single, recessive Mendelian trait.
- Confirmed a 1bp change (C>A) on chromosome 10 near the *PDX2* gene.
- The INDEL2 marker near *PDX2* is tightly linked to the albino phenotype. All albino plants are homozygous for the same allele of INDEL2 and all wildtype plants are either homozygous for a different allele of INDEL2 or heterozygous.

Future work:

- Confirm the genotype/phenotype correlation in by growing the progeny of the F2 plants to confirm the parental genotype.
- Analyze the expression of *PDX2* to determine if the mutation causes a decrease in gene activity.