Dormancy without reproduction

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Duckweed has growing and dormant phases with seasonal changes

- Frond: Growing phase, photosynthesis and biomass production
- Turion: Dormant phase, starch accumulation

Dormancy without reproduction


Turion formation

Out of the three APLs in Spirodela, APL2 is rapidly, APL3 steadily induced, whereas APL1 stays repressed.

Turions are heavier than fronds

Transmission Electron Microscopy

- Vacuoles
- Intercellular space
- Starch granules

ABA induction of turion formation

"After 3d in ABA, processes involved in turion formation had begun and could not be reversed."

**RNAseq of turion switch**

- **4X Control:** fronds with 0-day ABA
- **4X Treated:** Developing turions after 3-day ABA

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**RNAseq metrics**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Qualified total reads</th>
<th>Reads #</th>
<th>Map nuclear genome</th>
<th>Map chloroplast</th>
<th>Map mitochondria</th>
<th>Map rDNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>fronds 1</td>
<td>24,265,978</td>
<td>12,430,916</td>
<td>53%</td>
<td>20%</td>
<td>1%</td>
<td>4%</td>
</tr>
<tr>
<td>fronds 2</td>
<td>41,310,115</td>
<td>22,639,845</td>
<td>53%</td>
<td>37%</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>fronds 3</td>
<td>28,333,911</td>
<td>16,441,539</td>
<td>58%</td>
<td>29%</td>
<td>2%</td>
<td>6%</td>
</tr>
<tr>
<td>fronds 4</td>
<td>26,188,909</td>
<td>16,292,775</td>
<td>58%</td>
<td>30%</td>
<td>2%</td>
<td>9%</td>
</tr>
<tr>
<td>turions 1</td>
<td>26,484,222</td>
<td>15,431,023</td>
<td>58%</td>
<td>28%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>turions 2</td>
<td>28,495,211</td>
<td>16,123,639</td>
<td>57%</td>
<td>34%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>turions 3</td>
<td>20,754,352</td>
<td>15,697,393</td>
<td>61%</td>
<td>26%</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>turions 4</td>
<td>14,996,633</td>
<td>8,824,987</td>
<td>59%</td>
<td>29%</td>
<td>2%</td>
<td>1%</td>
</tr>
</tbody>
</table>

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**Differentially expressed genes**

RNA-Seq

- **Vegetative fronds - ABA**
- **Developing turions 3-day ABA**

<table>
<thead>
<tr>
<th>Fold change</th>
<th>4-5</th>
<th>5-10</th>
<th>10-15</th>
<th>15-20</th>
<th>&gt;20</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genes expressed lower in turions than fronds</td>
<td>37</td>
<td>73</td>
<td>12</td>
<td>10</td>
<td>22</td>
<td>154</td>
</tr>
<tr>
<td>Genes expressed higher in turions than fronds</td>
<td>38</td>
<td>97</td>
<td>25</td>
<td>15</td>
<td>33</td>
<td>208</td>
</tr>
</tbody>
</table>

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**Growth inhibition**

- Histone H3 and H4
- Ribosomal protein
- Expansins
- Aquaporins
- RuBisCO

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**Enhancement of secondary metabolism**

- LEAs for seed desiccation
- APL3 for starch biosynthesis
- oxidation for lipid degradation
- cellulose synthase for cell call biosynthesis
- Enzyme for anthocyanin synthesis
Duckweeds are aquatic plants that reproduce primarily by clonal propagation.

Although they rarely flower, they adapted a dormant and germinating phase without forming seeds.

Still genes that are expressed during the onset of dormancy are the same types observed during seed development, thereby providing an interesting new model for dormancy.