**Short Communication**

**Turion Induction in Spirodela polyrrhiza by Abscisic Acid**

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In an earlier publication (2) we found that dormant bodies called turions can be induced in some clones of *Spirodela polyrrhiza* (L.) Schleid. by a number of environmental manipulations. We now report the formation of turions under noninductive environmental conditions by abscisic acid (ABA) in concentrations as low as 0.01 µg/ml within 10 days.

Clones of *Spirodela polyrrhiza* were grown in varying concentrations of ABA. The cultures were grown aseptically in 2-inch specimen jars with the top of a 60 mm petri dish serving as a lid. Each culture contained 15 ml of 0.3 strength Hoagland's solution less copper (2) plus the designated concentration of ABA. The concentrations of ABA used are indicated in table I. The ABA was lot No. 1-7-0-0 from Shell Development Company and was a mixture of R and S forms. The cultures were placed in commercial growth chambers with four 25-Watt incandescent bulbs and six 40-Watt cool white fluorescent bulbs. The light intensity in the growth chambers was approximately 13,000 lux. The mean air temperature at the level of the culture dishes was 23° during the 20-hr photoperiod and 17° during the 4-hr dark period whereas the solution temperatures inside the cultures were 21° and 17° respectively. The difference in temperature between the air and the culture dishes reflects peculiarities of the light source and air conditioning patterns in these chambers. One full grown vegetative frond was added to each culture dish and 8 culture dishes were used for each ABA concentration. Several undeveloped fronds are usually concealed inside of each mature frond (1). The cultures were examined after 7, 10, and 14 days and the number of vegetative fronds and turions was recorded.

The above experiment was replicated in a second growth chamber with an 8-hr photoperiod. The temperature regime was the same as before except both in air and culture temperatures during the 16-hr dark period were 12°.

A parallel experiment using screw-capped glass vials laid at a 30° angle with 1 ml of 0.3 strength Hoagland's solution minus copper and concentrations of ABA of 1, 10⁻³, 10⁻², 10⁻¹, 10⁻⁰ µg/ml was established to ascertain threshold concentrations of ABA which could be detected by this bioassay procedure.

The effect of increasing ABA concentration on turion formation was investigated with 4 clones of *Spirodela polyrrhiza*. These are designated 4-66 (Vermont, USA), 2-66 (Puerto Rico), 1-66 (Argentina), and 16-62 (W. S. Hillman, Brookhaven National Laboratory). These clones differ in their response to gibberellic acid (GA₃) (2). Earlier work had indicated that clone 2-66 does not form

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Table I. *Effect of ABA on the Production of Fronds and Turions in Spirodela polyrrhiza, Expressed as the Means of 8 Replicates*

<table>
<thead>
<tr>
<th>Time in days</th>
<th>ABA Conc.</th>
<th>3</th>
<th>0.3</th>
<th>1</th>
<th>0.1</th>
<th>0.01</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fronds</td>
<td>µg/ml</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>Turions</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Fronds</td>
<td>2+</td>
<td>2+</td>
<td>2+</td>
<td>2+</td>
<td>2+</td>
<td>3+</td>
</tr>
<tr>
<td>7</td>
<td>Turions</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>Fronds</td>
<td>2+</td>
<td>2+</td>
<td>2+</td>
<td>2+</td>
<td>2+</td>
<td>5+</td>
</tr>
<tr>
<td>10</td>
<td>Turions</td>
<td>0.63</td>
<td>3.3</td>
<td>4.0</td>
<td>3.3</td>
<td>2.3</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>Fronds</td>
<td>2+</td>
<td>2+</td>
<td>2+</td>
<td>2+</td>
<td>2+</td>
<td>15+</td>
</tr>
<tr>
<td>14</td>
<td>Turions</td>
<td>0.63</td>
<td>5.7</td>
<td>6.0</td>
<td>5.0</td>
<td>3.4</td>
<td>0</td>
</tr>
</tbody>
</table>

= newly formed fronds or turions emerging from parental fronds.

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turions under any combination of photoperiod, temperature, or nutrient treatments (2).

Table I presents the results of turion formation and growth by clone 4-66 in response to different concentrations of ABA under the 20-hr photoperiod, 17°C dark temperature regime. Turion formation was induced within 10 days by all of the ABA concentrations tested. In the absence of ABA no turions were formed. However, all treatments including the controls formed turions in the 8-hr photoperiod, 12°C dark temperature chamber.

Clone 16-62 also formed turions readily in response to ABA. Clone 1-66 formed turions after 14 days in response to 0.1 µg/ml of ABA. Clone 2-66 did not form turions in response to any concentration of ABA tested including the relatively high concentration of 3 µg/ml.

The growth rate of clone 2-66 was not significantly affected by any concentration of ABA tested.

Thus some clones are induced to form turions in response to ABA treatment while others are not and turion formation by ABA sensitive clones, required different times and different concentrations of ABA for optimum response.

The parallel tests of the use of vials with 1 ml of nutrient solution plus various concentrations of ABA indicate that concentrations of 0.1 µg/ml exert their effect at the end of 4 days and concentrations of 0.01 µg/ml at the end of 10 days. Some experiments indicate that even lower concentrations of ABA may be effective after 20 days; however, at this time even the control treatments were beginning to show some turion formation, probably because of depletion of nutrients in the culture medium.

In Lemna minor under conditions of constant illumination Van Overbeek et al. (4) observed striking growth inhibitions by ABA, but no induction of turions.

After this manuscript had been submitted for publication Stewart (3) reported induction of turions by 0.15 µg/ml ABA in Spirodela polyrhiza, thereby independently arriving at conclusions similar to ours.

**Literature Cited**