Effect of Temperature on Growth of Shoot Apices Excised from Onions in Rest

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Abstract. Excised onion (Allium cepa L.) shoot apices exposed directly to temperatures of 10 to 15°C grew more than those excised from similarly treated half or whole bulbs. The temperature pretreatments which promoted the greatest growth of excised onion shoots at 20°C ranged from 5 to 12.5°C. Exposure to 30°C following a 10°C treatment negated the promotive effect of the lower temperature.

Temperature plays an important role in breaking rest of intact onion bulbs; 10 to 15°C are more effective in breaking rest and promoting sprouting than are lower or higher temp (1). Both continuous and intermittent temp treatments are effective (1, 4, 7, 12).

Sprouting is generally considered an indicator of the termination of rest in intact onion bulbs. However, the growing sprout leaf must grow through the storage scales before becoming visible and this process may take several months from the time rest was broken to the time the sprout emerges from the bulb (1). Jaffe and Isenberg (6) first showed the possibility of using the shoot apex as a tool to study onion rest and dormancy. Our purpose was to determine the effect of temp on growth of shoots excised from onion bulbs in rest.

Seeds of ‘Spartan Banner’, a good storage onion (8), were sown at the MSU Muck Farm. After harvest, the bulbs were cured 4 days by blowing forced air through crates of onions. All experiments reported were completed within one month of harvest and the bulbs were stored at room temp until used. The scales were removed from the bulbs, shoot apices were washed with distilled water and placed on moist filter paper in Petri dishes (Fig. 1A). After exposure to various temp regimes, the shoot apices were measured and planted in moist sand in the dark at 20°C. At the end of 96 hr, shoot length was measured (Fig. 1B), and expressed as a percentage increase over initial length. There was little or no growth of shoots during the period before planting in sand.

To study the effect of scales and temp treatment, a preliminary experiment was conducted using bulbs grown in the greenhouse. Whole bulbs, bulbs with the upper half removed, and excised apices were exposed to 10°C for 24, 48 and 72 hr. The shoot apices were then excised from the treated whole and half bulbs, and all apices were washed and planted as previously described. Ten shoots per treatment were used.

A second experiment using field grown bulbs was performed according to the above procedure except that the apices and whole and half bulbs were exposed to 10°C for 96 hr. Four replicates of 5 shoots per treatment were used. The control apices were removed from bulbs not exposed to temp below 20°C after harvest.

To determine the temp range most effective in promoting growth, excised shoots were exposed to 0, 5, 7.5, 12.5 and 20°C for 96 hr, and then planted as previously described. The effect of intermittent or continuous temp treatment was tested by exposing excised apices to 10°C with a 24 hr intervening period at 20 or 30°C. Four replicates of 5 shoots per treatment were used. The Petri dishes containing moist sand were arranged in a randomized complete block.

The preliminary experiment showed that shoot apices directly exposed to 10°C grew more when planted in moist sand at room temp than those shoots excised from similarly treated half and whole bulbs (Table 1). As the length of exposure to 10°C increased the greater was the growth of the excised apices at room temp. The time required for the apex to reach 100% from an initial temp of 20°C was approx 1 hr, 2 hr and 5 hr for excised apices, half bulbs and whole bulbs, respectively. The effect of temp pretreatment on subsequent growth of excised apices was confirmed using field grown bulbs. Even though the amount of time required for the apex tissue to cool down to 10°C was different for exposed excised apices, half bulbs, and whole bulbs, some other effect besides an insulation effect of the scales on the response to the temp pretreatment cannot be eliminated.

Results in Table 2 suggest that temp between 5.0 and 12.5°C are most effective in promoting growth of excised apices when subsequently planted in sand and held for 96 hr at 20°C. Higher and lower temp were much less effective. Abdalla and Mann (1) working with intact bulbs also found that intermediate temp (5° - 15°C) were more effective than either lower or higher temp in promoting sprouting. These results suggest that in excised shoot apices, synthesis of growth promoters and/or catabolism of growth inhibitors occurs at a faster rate at temp approaching 10°C than at either 0° or 20°C.

The promotive effect of 10°C on subsequent growth of excised onion shoots could be negated if followed by high temp and providing the temp was high enough (i.e. 30°C) (Table 3). This suggests that 30°C treatment inactivates growth promoters synthesized in the tissue at 10°C or perhaps, the high temp

Table 1. Effect of exposure of excised greenhouse-grown ‘Spartan Banner’ onion shoots, half and whole bulbs to 10°C for different periods of time on subsequent growth of excised shoots planted in moist sand in the dark at 20°C for 96 hr.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Time of exposure (hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Excised shoots</td>
<td>40.2 ± 5.6</td>
</tr>
<tr>
<td>Half bulbs</td>
<td>55.5 ± 2.3</td>
</tr>
<tr>
<td>Whole bulbs</td>
<td>40.6 ± 4.0</td>
</tr>
</tbody>
</table>

1Means and SE for 10 shoots.

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Effects of Cold Storage Duration on Bud Dormancy and Root Regeneration of White Ash (Fraxinus americana L.) Seedlings

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Additional index words. regeneration, potential, rest

Abstract. Root regeneration and time to first budbreak of two-year white ash (Fraxinus americana L.) seedlings were strongly correlated with the number of hours of chilling. Physiological dormancy of the buds was removed after approx 2500 hours of storage at 5 °C and this coincided with the beginning of increased root regeneration potential. Increased periods of chilling enhanced the rate at which growth was resumed after transfer of seedlings to environmental conditions adequate for growth. The present study indicates that fall-harvested white ash seedlings can be stored at 5 °C for at least until May without any apparent detrimental effects on root regeneration potential or seedling condition.

Successful establishment and growth of a transplanted seedling are dependent on its ability to initiate and develop new roots rapidly at time of planting (12). Root regeneration capacity has been used as a measure for assessing effects of various cultural and storage techniques on the physiological condition of nursery stock and is correlated with field survival and ease of transplanting (4, 6, 11, 12).

Unlike buds of temperate zone hardwoods, which show a period of dormancy or rest that can be removed by chilling (14), roots do not appear to exhibit a period of innate dormancy (9, 13). Root growth appears to be dependent on environmental parameters such as soil temperature, especially during spring and fall (7, 8). However, the endogenous control of root initiation in hardwoods apparently resides in the shoot (2, 5, 9). According to Richardson (9), silver maple (Acer saccharinum L.) seedlings require a physiologically nondormant bud to produce and export growth factors necessary for root initiation. Thus, in this species, root initiation is dependent on the state of dormancy of the buds which, in turn, is dependent on the amount of chilling received as the plant overwinters.

Table 2. Effectiveness of different temp in stimulating growth of excised ‘Spartan Banner’ onion shoots after 96 hr of exposure. Shoots planted in moist sand in dark at 20 °C for 96 hr after temp treatment.

<table>
<thead>
<tr>
<th>Expt.</th>
<th>Control</th>
<th>0°C</th>
<th>5.0°C</th>
<th>7.5°C</th>
<th>12.5°C</th>
<th>20.0°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>27.2a</td>
<td>49.3b</td>
<td>62.5c</td>
<td>40.2b</td>
<td>42.0b</td>
<td>19.3a</td>
</tr>
<tr>
<td>2</td>
<td>14.3a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Induction of secondary dormancy in ‘Spartan Banner’ onion shoots by high temp (30 °C) and its reversal by subsequent low temp treatments (10 °C).

<table>
<thead>
<tr>
<th>Temp treatment</th>
<th>Growth (% initial length)</th>
<th>Expt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°C</td>
<td>10 °C 20 °C 30 °C 40 °C</td>
<td>1</td>
</tr>
<tr>
<td>96</td>
<td>20.15a 39.75b 55.20c 38.47b</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>24.23a 44.92b 71.47c 45.49bc</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>16.25a 38.47b 67.32c 38.47b</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>10.80a 24.23a 44.92b 38.47b</td>
<td></td>
</tr>
</tbody>
</table>


Literature Cited