Effect of different salinity levels on *In vitro* and Ex vitro growth of potato

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Project Supervisor

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• Potato is a major food crop in Palestine. The annual consumption is about 100 thousands tons. Thus, a large amount of tubers is imported for this purpose.
Abstract

- *Solanum tuberosum* cv. Sponta explants grown in vitro on MS media, were subjected to 4 NaCl treatments. Meanwhile potato plants of two weeks age were subjected to the same levels of NaCl in the green house, growth and development of the plants and explants were analyzed. Plants were highly sensitive to salt treatment, both biomass and tuber production were influenced significantly.
Salinity is one of the major abiotic constraints that severely affect the productivity of agricultural crops in arid and semiarid regions

Salt stress limits yield of crops by

1. affecting the metabolism of plants and causes important modification in different biochemical and molecular processes (Allakhverdiev et al., 2000).

2. It can activate certain photosynthetic enzymes activity causing decomposition of membrane structures (Meloni et al., 2003).

3. Rate of photosynthesis and respiration in crop plants is severely interfered causing reduced plant growth and low productivity at high salts (Silva et al., 2001; Zhang et al., 2005; Fidalgo, 2004).
4. Higher level of salinity disrupts plant roots making water deficiency, nutrients imbalance by altering uptake and transport, ionic stress by higher Na\(^+\) and Cl\(^-\) accumulation, (Munns, 2002). 

5. Severe yield reduction in many crops has also been reported by Zhu (2007). FAO suggested that approximately 6% of the world’s total arable and 20% of irrigated land is affected by high salinity (FAO, 2008).
• Extensive breeding and selection in potato for traits other than abiotic stress tolerance have resulted in cultivars that are considered moderately salt tolerant (FAO, 2010).
The study of plant salt tolerance through tissue culture to identify crop sensitivity seems to be a fruitful and short time approach (Zhu, 2007).
Objectives

• Objective

• The objective of this project is to study the effect of different salt levels on the growth of potato plants through both *in vitro* and *ex vitro* technique
Methodology

• I. *In vitro* experiment
  • A. Potato incubation for sprouting under the room temperature with 16 hrs light and 8 hrs dark
  • B Sprouting
  • C. Sprout disinfestation using 10% chlorox and tween 20 (1 drop) then washing three times in sterile distilled water
Growing sprouts
Establishment

- Disinfestation
Media

- MS basal medium was prepared supplied with 30 gm per liter sucrose and 8 gm Defco Bacto agar, the media was dispensed in test tubes, the media was divided into four portion
  - 1. MS control medium
  - 2. MS + 50 mM NaCl
  - 3. MS + 100 mM NaCl
  - 4. MS + 200 mM NaCl
In vitro culture

- Sprouts were sterilized and cultured on media supplied with different levels of NaCl
- The culture were incubated in a growth chamber at 23± 2°C for 16 hrs light
Culturing under aseptic condition
Growth chamber
Green house experiment

• Potato tubers were planted in 10 liters pots filled with sand in the green house
• 32 pots were planted
• The pots were irrigated for two weeks with fresh water
• After 2 weeks, 16 pots of homogenous growth were selected, the four treatment (NaCl levels) (0, 50, 100, 200) were randomly assigned each in four pots (4 replicates), each pot was irrigated with the corresponding salt level.
Results

• *In vitro* Experiment
Effect of salinity on the average shoot length and number of potato plants *in vitro*

<table>
<thead>
<tr>
<th>Salt level (mM)</th>
<th>Av. shoot length (cm)</th>
<th>Av. Shoot number</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3.10 a</td>
<td>4.1*</td>
</tr>
<tr>
<td>50</td>
<td>3.10 a</td>
<td>3.1</td>
</tr>
<tr>
<td>100</td>
<td>1.70 b</td>
<td>3.8</td>
</tr>
<tr>
<td>150</td>
<td>1.40 b</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NS</td>
</tr>
</tbody>
</table>
Before treatment
Cultural practices
Labeling one shoot per plant
Initial stage
Treatment application
Control treatment
General effect of salinity
Stress development
High salinity effect
Effect of salinity on the average weight and number of tuber per plant

<table>
<thead>
<tr>
<th>Salt level (mM)</th>
<th>Weight tuber/plant (g m)</th>
<th>Average number of tuber per plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>43.70 a</td>
<td>5.8*</td>
</tr>
<tr>
<td>50</td>
<td>25.50 b</td>
<td>6.3</td>
</tr>
<tr>
<td>100</td>
<td>25.30 b</td>
<td>4.3</td>
</tr>
<tr>
<td>150</td>
<td>18.50 b</td>
<td>5.5 NS</td>
</tr>
</tbody>
</table>
Effect of salinity on the average biomass of potato plants

<table>
<thead>
<tr>
<th>Salt level (mM)</th>
<th>Total biomass (gm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>88.33 a</td>
</tr>
<tr>
<td>50</td>
<td>59.7 b</td>
</tr>
<tr>
<td>100</td>
<td>59.5 b</td>
</tr>
<tr>
<td>150</td>
<td>46.7 b</td>
</tr>
</tbody>
</table>
Conclusion

• 1. Potato Sponta cultivar is sensitive to salinity
• 2. The effect was more exhibited in greenhouse trial
• 3. Growth and tuber production was highly affected with salinity treatment
• 4. Other cultivars should be investigated and screened for salt tolerance