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In vitro evaluation of biochemical parameters for selected barley cultivars grown under salinity and alkalinity stresses

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Outline:

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Quarries

➢ Stone and marble industry in Palestine (locally named white-gold) is considered the main extractive industry in Palestine concentrated mainly in Nablus, Jerusalem and Hebron cities.

➢ In quarrying area, the soil attributes to the high concentrations of hydroxyl (OH–), carbonate (CO₃ -2 ) and bicarbonate (CHO₃ - ).
Salinity

- Soil salinity is one of the major abiotic environmental stresses and the most widespread land degradation problems.

- These soils constitute nearly 7% of the total land area or nearly 33% of the potential agricultural land area of the world.
Alkalinity

- Soil alkalinity is defined as the state resulting from the accumulation of soluble salts in the soil.

- Mainly alkaline conditions are caused by a high concentration of sodium carbonate.

- Injuries due to alkaline conditions are more pronounced than those caused by salinity.
Barley:

- Tolerance plants a way to reclaiming alkaline and saline soil.

- Barley considered as one of the tolerance plant.

- Biochemical parameters will be measured to determine the effect of salinity and alkalinity in barley.
Biochemical parameters

Chlorophyll Fluorescence

• Chlorophyll fluorescence measurement is a relatively new technology.
• Used to study the impact of various stresses on photosynthetic efficiency of leaves.
• Used to monitor growth, physiological response, and PSII changes in plants under stress.
• The total chlorophyll fluorescence amount is only 1 to 2% of the total light absorbed
Biochemical parameters

Total chlorophyll content

- Chlorophyll is the most important class of pigments involved in photosynthesis.
- Amount of chlorophyll in leaf tissue is influenced by nutrient availability and environmental stresses.
Biochemical parameters

Leaf Relative Water Content (RWC)

- RWC is a measure of leaf hydrates state.
- It is indicator of the state of water balance of a plant.
- Normal values of RWC range between 98% in turgid leaves to about 40% in dying leaves.
Biochemical parameters

Leaf extract pH

- Stable tissue pH is necessary for plants to keep normal metabolism.
- Lower pH readings usually indicate low levels of light, low microbial activity.
- High pH often indicates excessive heat, an excess of cations.
Problem statement

- Two kinds of stresses are exerted on plant cultivation; biotic and abiotic stresses.

- Recently, quarries are considered as a cause of abiotic stress due to their effect on air pollution, increased salinity and alkalinity of soil.

- Exploring plants capable to compromise with these stresses has received great interest. In this research project, we aim to evaluate varieties of barley during the early growth stage for their resilience to high salinity, alkalinity and both of them.

- Biochemical parameters such as leaf extract pH, relative water content, chlorophyll contents, photosynthesis rate and ascorbic acid content will be measured.
Aims and Objectives:

The main aim:
To investigate the efficiency of Palestinian Barely growth and development under salinity and alkalinity stress.

The main objectives:

❖ To investigate the mechanisms of stress tolerant throughout measuring the biochemical parameters of the selected barley cultivars.

❖ To determine the best barley cultivar(s) suitable for cultivation in areas suffering from abiotic stresses caused by quarries.
Methods

1- Measurement of relative water content:

\[
RWC = \frac{\text{Fresh weight-Dry Weight}}{\text{Turgid Weight-Dry Weight}} \times 100\%
\]
2- Measurement of leaves extract pH:
3- Measurement leaf chlorophyll content:
4-Measurement of the quantum yield of photosystem II by (PAR-FluorPen FP 110):
Results and Discussion
Alkalinity-stress effect on chlorophyll content in three barely cultivars

Chlorophyll content of three Palestinian barely cultivars (ICARDA, ACSAD and Improved Baladi) growing under the effect of 0, 50, 85 and 120 mM CaCO$_3$. 
Alkalinity-stress effect on the quantum yield of PSII in three barely cultivars

Photosystem II quantum yield of three Palestinian barely cultivars (ICARDA, ACSAD and Improved Baladi) growing under the effect of 0, 50, 85 and 120mM CaCO₃.
Effect of alkalinity stress on RWC in three barely cultivars

Relative water content of three Palestinian barely cultivars (ICARDA, ACSAD and Improved Baladi) growing under the effect of 0, 50, 85 and 120 mM CaCO$_3$. 
The effect of alkaline-stress on pH content in three barely cultivars.

<table>
<thead>
<tr>
<th>Salinity</th>
<th>ICARDA</th>
<th>ACSAD</th>
<th>I.B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5.9±0.28</td>
<td>5.81±0.06</td>
<td>5.91±0.11</td>
</tr>
<tr>
<td>50</td>
<td>5.87±0.08</td>
<td>5.66±0.14</td>
<td>5.84±0.15</td>
</tr>
<tr>
<td>85</td>
<td>5.93±0.32</td>
<td>5.81±0.17</td>
<td>5.76±0.21</td>
</tr>
<tr>
<td>120</td>
<td>5.69±0.43</td>
<td>5.80±0.04</td>
<td>6.14±0.19</td>
</tr>
</tbody>
</table>

Value represent mean ±standard deviation in categories column
Conclusion

- Alkalinity stress menace the early seedling growth of the certified 3 Palestinian barely cultivars. Increased alkalinity stress reduce the chlorophyll content, photosystem II quantum yield and relative water content of Improved Baladi cultivar indicating that it’s the most sensitive cultivar.

- ICARDA1 can be classified as a moderately tolerance to alkaline stress based on these parameters. ACSAD1417 is the most resistant one during early growth stage (30 days) old due to high chlorophyll content, relative water content of 95.5% and high photosystem II quantum yield at 120 mM CaCO3. Based on the above-mentioned evident, we highly recommend ACSAD 1417 for the cultivation in the quarries, their landfills and nearby areas.
Recommendations

❖ More research is needed to determine the impact of alkalinity on various Palestinian national crops.

❖ Field experiments in known alkaline soil areas are needed to ensure the tolerance of these cultivars to poor alkaline soils.

❖ Assessment of other chlorophyll fluorescence parameters along with QY is recommended to have more helpful information about the activity of photosystem II under alkaline stress.
Acknowledgements

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ANY QUESTION?