PEP-Carboxylase Activity Supports Organic Acid Metabolism of Maize (*Zea mays*) under Salt Stress

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Surprising result

Effect of salt stress on the PEP-carboxylase activity in young shoots of various maize hybrids

Effect of salt stress on the PEP-carboxylase activity in old shoots of various maize hybrids
Hypotheses

• Enhanced PEP-carboxylase activity in young shoots increases sugar concentrations

• Enhanced PEP-carboxylase activity in young shoots increases organic acid concentrations

PEP + CO₂ → PEP carboxylase → Oxaloacetate

CO₂ + OH⁻ + P → PEP carboxylase → Pyruvate

Malate → Oxaloacetate → Sugar

COOH
C—O
CH₂

COOH
C—O
CH₂
Experimental approaches

• Comparison of maize (*Zea mays* L. hybrid SR 03) as a C\(_4\) plant with wheat (*Triticum aestivum* L. cv. Thasos) as a C\(_3\) plant

• Effect of two different light intensities on the concentrations of sugars and organic acids in young shoots
Material and Methods

**Material:**
- Maize (*Zea mays* L. hybrid SR 03*)
- Weizen (*Triticum aestivum* L. cv. Thasos)

**Plant cultivation:**
- growth chamber 330 W m⁻² and 200 W m⁻²
  - 26°C, 16 h (day); 18°C, 8 h (night)
- standard nutrient solution (± salt)

**Salt treatment 100 mM NaCl**
- 13th day: 25 mM NaCl
- 14th day: 50 mM NaCl
- 15th day: 75 mM NaCl
- 16.- 20th day: 100 mM NaCl, 20th day: harvest

*Information on the development and salt resistance of maize hybrid SR 03:*
Material and Methods

Parameters:

- Fresh weight
- PEP-carboxylase activity
- Glucose, fructose and sucrose concentrations
- Malate concentrations
- Alkalinity
Determination of alkalinity

- Conversion of organic anions into carbonates by ashing at 500°C
- Solubilization of carbonates with excess acid
- Back-titration with NaOH for the determination of residual acid
Effect of salt stress on the shoot fresh weights of wheat and maize under two different light intensities
Effect of salt stress on the PEP-carboxylase activity in young shoots of wheat and maize under two different light intensities
Effect of salt stress on the glucose and fructose concentrations of young shoots of wheat and maize under two different light intensities
Regeneration of PP$_i$ as substrate for the pyrophosphatase H$^+$ pump

Effect of salt stress on the sucrose concentrations of young shoots of wheat and maize under two different light intensities

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>100 mM NaCl</th>
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<tbody>
<tr>
<td>Shoots</td>
<td>Wheat</td>
<td>Maize</td>
</tr>
<tr>
<td>330 W m⁻²</td>
<td>*</td>
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<tr>
<td>200 Wm⁻²</td>
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Note: * indicates significant difference.
Effect of salt stress on the alkalinity in young shoots of wheat and maize under two different light intensities
Effect of salt stress on the malate concentrations in young shoots of wheat and maize under two different light intensities.

The bar chart shows the malate concentrations (mg/g fresh weight) for wheat and maize under 330 W m⁻² and 200 W m⁻² light intensities. The bars are color-coded with blue for wheat and red for maize. Asterisks denote significant differences.
Conclusions

• Enhanced PEP-carboxylase activity in young shoots of maize under salt stress *does not* increase sugar supply via the $C_4$ pathway. This is in agreement with the finding that osmotic adjustment does not limit growth*.

• Enhanced PEP-carboxylase activity in young shoots of maize maintains organic acid metabolism under salt stress**.


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