Photosynthesis-related Stress on Plants and Their Resistance to It

Masaaki Takahashi
Laboratory of Plant Molecular Biology, Department of Applied Life Sciences
Graduate School of Life and Environmental Sciences, Osaka Prefecture University

Chlorophyll Itself was Gained as a Light Guard

Solar Energy is Used to Drive Creative or Non-creative Reactions in Oxygenic Photosynthetic Organisms
Reactive Oxygen Species (ROS); Unavoidable Gifts from Oxygenic Photosynthetic World

Oxygen Metabolism in the Chloroplast

Photorespiratory Pathway
Photorespiration (CO₂ Burst) Highly Depends on Glutamine Synthetase (GS2) Activity
NH3 Accumulates in Chloroplasts when CO₂ Flow is Shut Down

GS2 Transgenic Plant is Not Photoinhibited
GS2 Transgenic Plant is Not Photoinhibited

C4 Photosynthesis was Evolved ~70 Million Years Ago to Cope with Recent Climate Changes by Dissipating Solar Energy Once Absorbed

**cyppdkZm1 Promoter**

```
TATAAA  CAGGCCCTATGCCGCCGCTTGGTGAG
```

**C4ppdkZm1 Promoter**

```
TATAAA  CAGGCCCTATGCCGCCGCTTGGTGAG
```

<table>
<thead>
<tr>
<th>Transcript</th>
<th>Start</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>transit peptide</td>
<td>ATG</td>
<td>C4ppdkZm1 intron1</td>
</tr>
</tbody>
</table>

**cyppdkZm1 Promoter**

```
TATAAA  CAGGCCCTATGCCGCCGCTTGGTGAG
```

**C4ppdkZm1 Promoter**

```
TATAAA  CAGGCCCTATGCCGCCGCTTGGTGAG
```

<table>
<thead>
<tr>
<th>Transcript</th>
<th>Start</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>transit peptide</td>
<td>ATG</td>
<td>C4ppdkZm1 intron1</td>
</tr>
</tbody>
</table>

**cyppdkZm1 Promoter**

```
TATAAA  CAGGCCCTATGCCGCCGCTTGGTGAG
```

**C4ppdkZm1 Promoter**

```
TATAAA  CAGGCCCTATGCCGCCGCTTGGTGAG
```

<table>
<thead>
<tr>
<th>Transcript</th>
<th>Start</th>
<th>End</th>
</tr>
</thead>
<tbody>
<tr>
<td>transit peptide</td>
<td>ATG</td>
<td>C4ppdkZm1 intron1</td>
</tr>
</tbody>
</table>
Nitrate Assimilation by Plant – The Role of the Nitrite Transporters (CsNitr1-L&-S) –

Uptake of NO₂, NO, and CO₂ by the Nitrite Transporter (CsNitr1-S) Transgenic Arabidopsis
NO$_2$ Assimilation by the Nitrite Transporter (CsNitr1-S) Transgenic Plant

Path for the Atmospheric CO$_2$ and NO$_2$ to Plant Cells
Phenotypic Difference of Nitrite Transporter (CsNitr1-S) Transgenic Arabidopsis from Its Control (Col-0)

Laboratory of Plant Molecular Biology (Ex-Laboratory of Soil and Plant Biosciences)

Masaaki Takahashi
Miwa Sugiura
Sustiprijatno
Mihaela N. Georgescu
Grant A. Griffith