Monitoring physiological status of Norway spruce trees in the Krušné hory in 2000: selected metabolic, histochimical and spectral analyses

Alena Stejskalová, Jana Albrechtová, Tamás Palek, Ryan Hamley, Barrett N. Rock

Department of Plant Physiology Charles University, Vinicná 5, Prague 2, 128 44, Czech republic

University of New Hampshire, Morse Hall, Durham, NH 03824, USA

RESULTS

• To estimate physiological status of Norway spruce trees in the Western and Central Krušné hory in 2000 using comparison of biochemical, histochimical and spectral analyses of Norway spruce needles.

• Are there any differences in histochimical localization of chemical compounds in needles depending on age and/or damage?

INTRODUCTION

The massive decline of Norway spruce (Picea abies (L.) Karst.) has been observed in the Krušné hory during the last few decades. Before macroscopic changes occur (e.g. needle yellowing and foliar life), the effect of stress factors is initially recognizable as the metabolic and microscopic changes. Phenolic compounds, lignin and photosynthetic pigments seem to be good indicators of needle pre-viable damage. Also, spectral indices seem to be good stress markers. Based on our previous research [1], the present study focused on a detailed study of physiological status of adult Norway spruce trees in the western and central parts of the Krušné hory in the year 2000.

MATERIAL

• Adult trees from five sites located in the western and central parts of Krušné hory: the three youngest needle age classes (NACs) from trees more than 80 years old were collected October 4, 2000 (Fig. 1).

METHODS

Biochemical analyses:

• Determination of a percentage of crown defoliation using the series of visual assessment of the damage to a tree. The total number of trees was 200 from the Krušné hory (Tab. 1).

Histochemical detections show only damage-dependent accumulation of different lipid compounds in mesophyll cells and dermal tissues of Norway spruce needles (Graph 1).

Lipid compounds:

• Localization of studied chemical compounds detected in different parts of the needle: Sudan 7B, Phloroglucinol, Vanillin, Fast Blue BB Salts (Fig. 2).

3) Spectral data

• Theoretically, at wavelengths characteristic of water in vegetation, lower reflectance was found in needles of NAC 1 as can probably explain an absence of water stress in youngest needles (Graph 2). The reflectance at 1122 nm in Site 3 (Central KH) was highest REIP value.

CONCLUSIONS

• High concentrations of photosynthetic pigments indicate good physiological status of trees even with high macroscopic damage, i.e. high damage class.

• Histochemical detections show only damage-dependent accumulation of lipid compounds in mesophyll cells and dermal tissues of needles.

• Spectral indices show that trees from Krušné hory had quite good physiological status.

REFERENCES


Acknowledgement

For financial support, we thank the Ministry of Education of the Czech Republic for the research project 1M06051 and the grant of AS CR, project M10059.

Tab. 1 Degree of site damage on five sites in Krušné hory in year 2000 using comparison of biochemical, histochemical and spectral analyses. [ ] indicates significant difference (p < 0.05).

<table>
<thead>
<tr>
<th>Site</th>
<th>Western KH</th>
<th>Central KH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.0</td>
<td>5.0</td>
</tr>
<tr>
<td>2</td>
<td>6.0</td>
<td>9.0</td>
</tr>
<tr>
<td>3</td>
<td>1.0</td>
<td>3.0</td>
</tr>
<tr>
<td>4</td>
<td>2.0</td>
<td>4.0</td>
</tr>
<tr>
<td>5</td>
<td>5.0</td>
<td>7.0</td>
</tr>
</tbody>
</table>