DIURNAL COURSE OF PHOTOCHEMICAL REACTIONS IN A CANOPY PLANT UNDER FLUCTUATING ENVIRONMENT

Denný priebeh fotochemických reakcií porastovej rastliny vo fluktujúcich environmentálnych podmienkach

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Poľné plodiny v generatívnej fáze musia obyčajne znášať početné environmentálne stresy. Cieľom tejto práce bolo preto nahliadnuť do zmien fotochemických reakcií odohrávajúcich sa počas dňa u porastových rastlín jarného jačmeňa. Prišli sme k záveru, že fotoinhibícia pri treťom (spodnom) liste je spôsobená prevážne pokročilou senescenciou listu, pri zástavkovom najväčšou expozíciou. Podzástavkový list trpí fotoinhibíciou minimálne, čo potvrdzuje jeho kľučové postavenie v procese napĺňania zŕn u jačmeňa.

fotochemická efektívnosť, fotosyntetické pigmenty, jačmeň

Summary, keywords

Crops usually suffer from many environmental stressors in the generative phase of their onthogeny. Therefore, our objective was to bring a view into diurnal changes in photochemical reactions of spring barley plants. We found out that whereas in the third (lowest) leaf present photoinhibition is caused by mesophyll senescence and in the flag leaf by its overexposition, the penultimate leaf receives only a small part of photochemistry injury. It documents an importance of the penultimate leaf for the grain filling processes in barley.

photochemical efficiency, photosynthetic pigments, barley

Introduction - Úvod

The generative phase of crops onthogeny is in natural conditions usually affected by cumulatively and at each level acting environmental stressors, which could reduce the photosynthetic performance and thus yields - in various range and different yield characteristics.

Purpose of this work was to bring information how the photosynthetic apparatus of a canopy plant (spring barley) responds to diurnal changes of environmental factors.

Methods - Metody

Spring barley plants (cv. Kompakt, SK) were grown externally in 10 l pots with soil substrate. Water supply was maintained at 70% of maximal soil water capacity. In the milk-ripeness stage, using portable fluorometer Mini-Pam (Walz, Germany), we determined in flag-, penultimate- and third (the lowest functioning) leaf, respectively: **1. actual photochemical efficiency** ($\Delta F/F_m'$) under natural light conditions, every 30' from 6:30 a.m. to 1:00 p.m. **2. rapid light curves** (RLC), applied automatically (light intensities approximately 110, 170, 250, 390, 540, 840, 1250, 1890 $\mu mol.m^{-2}.s^{-1}$, 15'' light intensity duration interval), in the morning, at 2:15 and 5:15 p.m., after 30' dark incubation. Parameters required (yield, ETR, 1-qP, NPQ) were calculated automatically or manually.

The first value of the yield dynamics (RLC) was taken as the **3. maximal photochemical efficiency** (F_v/F_m).

Simultaneously, **4. photosynthetic pigments content** of leaves in all of the canopy floors was ascertained (using spectrophotometer Spekol, Karl-Zeiss, Germany). **5. Air temperature, PAR intensity and relative humidity** were recorded continuously (in 5' or 15' interval, micrometeorological station Li-1400).

Results - discussion – Výsledky - diskuse

The actual photochemical efficiency in respect to increasing PAR intensity remains mostly at the highest level in penultimate leaf (in the morning almost equal to the flag leaf), followed by flag- and the third leaf. Similar results were obtained when we concentrate on the yield (RLC). Moreover, the ETR multiplied differences between leaves. What is interesting, the NPQ dynamics in the third leaf maintained high, though the portion of the xanthophyll-cycle use in energy dissipation declined in the course of the day, generally (relatively consistent with 1-qP). The recovery analysis also shows that the most suffering leaf is the third one (especially round the midday). The pigments content has a decreasing tendency in direction deeper into the canopy. Chlorophyll a/b ratio remains stable. Regarding the climatic parameters, extreme conditions occurred for 5-7 hours a day. The reason for the largest injury in the third leaf could be a developed senescence associated with pigments decomposition, enzymes and antioxidants destruction, although the xanthophyll cycle-dependent energy dissipation is in order. The flag leaf, which is much better photoprotectively equipped, with a good recovery ability, undergoes a partial photoinhibition due to the large exposition. It is known that the penultimate leaf plays the most important role in barley during the grain filling period. Our results just confirm this statement (it exhibits a minimal photoinhibition).