BRIEF COMMUNICATION

Influence of temperature increase on evapotranspiration rate and cytokinin content in wheat seedlings


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Abstract

The content of cytokinins especially zeatin nucleotide decreased in shoots as a result of temperature increase. Simultaneously the cytokinins accumulated in roots. The changes in cytokinins distribution were followed by a decline of evapotranspiration after its initial temperature-induced uprising.

Additional key words: Triticum durum, zeatin, zeatin-9-N-glucoside, zeatin nucleotide, zeatin riboside.

Phytohormones are known to regulate plant water relations. Fine control of stomatal movements by CO₂ and phytohormones (ABA, IAA and cytokinins) means that a plant can vary its priorities according to the water supply (Davies et al. 1986, Maasfield et al. 1990, 1995). There are some reports showing the changes in the level of cytokinins and their redistribution between shoots and roots as a result of temperature increase (e.g. Itai et al. 1973). In this paper we compare the changes in cytokinins composition and evapotranspiration rate in response to the temperature increase.

Seeds of Triticum durum L. cv. Bezenchokskaya 139 were grown in containers with nutrient solution under irradiance of 90 W m⁻² PAR and 14-h photoperiod. Seedlings were grown at temperature 24 °C for 7 d and then the temperature was increased up to 27 °C. Evapotranspiration rate was measured by weighing the pots.

Extraction of cytokinins was carried out with 80 % ethanol. Cytokinins from aqueous residue were concentrated on C18 column (RP-C₁₈, Varian, Harbor, USA) and, after washing the loaded column with 20 cm³ of distilled water, eluted with

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5 cm$^3$ of 80 % ethanol. The solvent was evaporated to dryness, the residues were dissolved in 0.02 cm$^3$ of 80 % ethanol and applied to precoated 5 × 20 cm, 0.25 mm thick silica gel 60 F-254 plates (Merck, Darmstadt, Germany) for thin layer chromatography. Solvent was 2-butanol-1-ol, 14 M NH$_4$OH and H$_2$O (6:1:2, v/v, upper phase). The zones were eluted with 0.1 M phosphate buffer (pH 7.4) for 12 h and added directly to the wells of microplate in several dilutions for immunoassay using antibodies against zeatin riboside shown to be highly specific to some zeatin derivatives (Kudoyarov et al. 1990). TLC-immunoassay enabled separation and estimation of zeatin nucleotide (ZN, Rf 0 - 0.1), zeatin-9-N-glucoside (ZG, Rf 0.2 - 0.3), zeatin riboside (ZR, Rf 0.4 - 0.5) and free zeatin (Z, Rf 0.6 - 0.7). 7-N- and 0-glucosides that may also be present in the zone of zeatin-9-N-glucoside have very low cross-reactivity to antibodies used in this work and do not influence the results of immunoassay. All the standards of zeatin derivatives were from Apex Organics (Honiton, UK).

The evapotranspiration rate under normal growth temperature was approximately 14 ± 1 µg plant$^{-1}$ s$^{-1}$. During the first hour after the change in temperature, it increased 3-fold up to 36 ± 2 µg plant$^{-1}$ s$^{-1}$. During a next hour evapotranspiration decreased and reached again the initial value. The first phase of the transient course of evapotranspiration can be explained by the increase in temperature itself. The second phase, the decline in evapotranspiration, suggests the occurrence of a regulating mechanism.

Fig. 1. Effect of temperature increase from 24 °C up to 27 °C on the concentration of zeatin nucleotide (ZN), zeatin-9-N-glucoside (ZG), zeatin riboside (ZR) and free zeatin (Z) in shoots and roots of 7-day-old wheat seedlings.