Local impacts of climatic variations on the physiological processes of maize in Hungary

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The goal of the present study is to investigate the local effects of global warming on maize's stomatal resistance and photosynthetic intensity using the modeling tool. In our study we applied the Crop Micrometeorological Simulation Model (CMSM) of *Goudriaan* (1977) modified by *Chen* (1984). The basis of the functioning models follows the way of the incident solar radiation in the different layers of the canopy. The inputs of the model were collected at Keszthely Agrometeorological Research Station (Hungary). Our purpose was to get information about the response of locally grown maize to the possible climate variation.

In the simulation four scenarios were applied. In the following description only those input parameters are mentioned that we have changed during the simulation runs.

1. The control data represent the present climatic conditions regarding the local measurements of hourly meteorological data, average soil moisture content, and 380 ppmv CO_2 concentration. The value of LAI was 2.8, the characteristic mean for maize grown at Keszthely.
2. In the first scenario the CO_2 concentration was doubled together with 3˚C increase in hourly air temperatures. We kept doubled CO_2 level constant in the later scenarios.
3. In our second scenario we used 760 ppmv CO_2 level and an increased air temperature of 3˚C. In addition to increases in CO_2 level and warming of 3˚C, we reduced the soil moisture by 43%, and decreased LAI to 2.3.
4. In the third scenario only the soil water content was decreased further (close to wilting point) while the other inputs were kept constant. We used a reduced LAI of 1.6.

In the first scenario the daytime average of stomatal resistance was 55% higher than the control run. In case of second scenario the reduced soil water caused further growth in mean stomatal resistance (77%). Regarding our third scenario the highly reduced soil water content closed the stomata before solar noon, at 11 o'clock. In this period the stomatal resistance was 158% higher than in the same period of the control run.

The increased amount of atmospheric CO_2 has positive influence regarding the photosynthetic intensity. The growth in the daily average of net production was 24% in the first scenario. In the second scenario with reduced water supply the maize should avoid the water losses. To achieve this purpose the stomatal closure was more intensive than in the control run. In spite of increasing level of CO_2 in the ambient air, the gas amount used in photosynthesis hardly grew, so the parameter increase was just 1.7% respect the control. In our third model run stomata were open just four hours, so in daily mean the photosynthetic intensity is 44% lower than the control run.

Elevated CO_2 concentration could equilibrate the effect of increased air temperature and reduced soil water content on the photosynthetic intensity of maize only on a very narrow domain in the time period of late August. The compensation effect of CO_2 was low comparing to the negative influences connected to the changes in meteorological elements.