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Changes in radiative properties of soot contaminated maize canopy

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The effect of particle (Black Carbon, BC) on certain radiative characteristics of maize plants was studied over 2011 growing season in a field experiment carried out in Keszthely Agrometeorological Research Station. As the main constituent of BC, the soot that is almost exclusively responsible for light absorption by particles in the atmosphere, thus changing the radiation balance of the Earth and contributing to global warming. Maize hybrid Perlona (FAO 340) with short-season was applied as test plant. Of the two water supply treatments, the rainfed variant was sown in field plots, while compensation evapotranspirometers of the Thornthwaite type were used for the "ad libitum" treatment. The BC applied as pollutant was coming from the Hankook Tyre Company (Dunaújváros, Hungary), where it is used to improve the wear resistance of the tyres. The black carbon was chemically "pure", i.e. it is free of other contaminants (heavy metals etc.), so the reproducibility of the experiment is not problematic, unlike that of tests on other atmospheric air pollutants. Road traffic was simulated by using frequent low particle rates (3 g m–2 week–1) with a motorised sprayer of SP 415 type, during the season. The leaf area index was measured each week on the same 12 sample plants in each treatment using an LI 3000A automatic planimeter (LI-COR, Lincoln, NE). The impact of black carbon on plant radiative properties were analysed in the field (about 0.3 ha/treatment). Pyranometers of the CMA-11 type (Kipp & Zonen, Vaisala) were installed on columns of adjustable height in the centre of the 0.3 ha plots designated for albedo measurements. Data were collected using a Logbox SD (Kipp & Zonen, Vaisala) datalogger in the form of 10-minute means of samples taken every 6 seconds.
BC pollution had no effect on maize growth and development. Compared with soot contaminated and control plants, we concluded that the LAI was a few percent higher in polluted plants, but this increment was not always proved statistically. Albedo reduced significantly in the polluted maize stand. Decline in reflectance of maize with soot cause an increase in net radiation. The latent heat of soot contaminated plants was higher, in contrast to the sensible heat. The ability of soot to absorb irradiation increased the absolute values of energy (latent and sensible heat fluxes) in polluted canopy. The Bowen ratio of polluted crops declined below the control values, probably because it was a dry summer, except a few days. Season of 2011 was characteristic of arid, dry summer minimum rainfall.

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