

Growth and Yield Response of an Indian Wheat Cultivar (HD 2967) to Ozone and Water Stress in Open-Top Chambers with Emphasis on Its Antioxidant Status, Photosynthesis and Nutrient Allocation

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Abstract : Agricultural sector is facing a serious threat due to climate change and exacerbation of different atmospheric pollutants. Tropospheric ozone (O_3) is considered as a dynamic air pollutant imposing substantial phytotoxicity to natural vegetations and agriculture worldwide. Naturally, plants are exposed to different environmental factors and their interactions. Amongst such interactions, studies related to O_3 and water stress are still rare. In the present experiment, wheat cultivar HD2967 were grown in open top chambers (OTC) under two O_3 concentration; ambient O_3 level (A) and elevated O_3 (E) (ambient + 20 ppb O_3) along with two different water supply; well-watered (W) and 50% water stress conditions (WS), with an aim to assess the individual and interactive effect of two most prevailing stress factors in Indo-Gangetic Plains of India. Exposure to elevated O_3 dose caused early senescence symptoms and reduction in growth and biomass of the test cultivar. The adversity was more pronounced under the combined effect of EWS. Significant reduction of stomatal conductance (gs) and assimilation rate were observed under combined stress condition compared to the control (AW). However, plants grown under individual stress conditions displayed higher gs, biomass, and antioxidant defense mechanism compared to the plants grown under the presence of combined stresses. Higher induction in most of the enzyme activities of catalase (CAT), ascorbate peroxidase (APX), glutathione reductase (GR), peroxidase (POD) and superoxide dismutase (SOD) was displayed by HD 2967 under EW while, under the presence of combined stresses (EWS), a moderate increment of APX and CAT activity was observed only at its vegetative phase. Furthermore, variations in nutrient uptake and redistribution to different plants parts were also observed in the present study. Reduction in water availability has checked nutrient uptake (N, K, P, Ca, Cu, Mg, Zn) in above-ground parts (leaf) and below-ground parts (root). On the other hand, carbon (C) accumulation with subsequent C-N ratio was observed to be higher in the leaves under EWS. Such major nutrient check and limitation in carbon fixation due to lower gs under combined stress conditions might have weakened the defense mechanisms of the test cultivar. Grain yield was significantly reduced under EWS followed by AWS and EW as compared to their control, exhibiting an additive effect on the grain yield.

Keywords : antioxidants, open-top chambers, ozone, water stress, wheat, yield

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