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"Development on the margin"

Effect of Elevated Tropospheric Ozone on the Grain Quality of Rice

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Abstract

Many emerging Asian countries are experiencing dynamic economic growth, which has led to environmental problems such as rising air pollution. In large parts of India and China, tropospheric ozone concentrations above 60 ppb are seen frequently even in rural areas, which affects both human health, and the productivity of agricultural crops. In the coming decades, ozone concentrations are expected to rise even further in these parts of the world due to the combined effects of global change and economic growth. Ozone affects rice production in various ways. It is taken up through the stomata during photosynthetic gas exchange and causes reduced photosynthetic capacity, oxidative stress, accelerated senescence, and ultimately a reduction in yields that can reach more than twenty percent. The quality of rice straw has also been shown to be affected by ozone. However, the effects of ozone on the quality of the rice grain have not been investigated in detail.

Ozone fumigation experiments were conducted in Akagi (Japan), in which plants from eight different rice genotypes were exposed to four different ozone concentrations throughout the growing season: charcoal filtered air (= clear air with almost no ozone), ambient ozone concentration, $2 \times$ ambient ozone concentration, and $2.5 \times$ ambient ozone concentration. Grain samples were taken at maturity, and were analysed for grain quality traits. Protein concentration increased consistently with increasing ozone dose in most genotypes. Phenolics concentration was strongly elevated in pigmented genotypes but did not show any response to ozone fumigation. Iron and zinc concentration were differently affected in different genotypes, showing ozone induced increases in certain varieties and decreases in others. Further analyses are being carried out to investigate crude lipid concentration, thousand kernel weight, grain colour and shape, as well as viscosity. This study suggest that grain quality is affected by ozone, and that genotypic difference occur in the response to ozone stress.

Keywords: Environmental stress, food security, global change, ozone, rice

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