

Ground-level ozone: a threat to rice crop in Muda irrigation area of Peninsular Malaysia.

ABSTRACT

It has long been recognized that pollutant gases cause significant impacts on crops and forests in both developed and developing countries. Ground-level ozone (O₃) or better known as tropospheric ozone is recognised as the pollutant most likely to cause widespread crop damage. For this pollutant an AOT40 (accumulative O₃ concentration above a threshold of 40 ppb) value causing 5% yield loss for all agricultural crops has been established as 3000 ppb·h, which is applicable during daylight hours over a growing season (UN-ECE, 1996). In order to have a complete estimate of air pollution damage i.e., O₃ to paddy plantation area, a dose-response, or yield-loss function have to be developed. In this study, data was gathered from tests in open-top chambers (OTCs), whereby four OTCs were fabricated; two of which were exposed to ambient air pollution (NF) of which ozone is the major perpetrator whilst the remaining were provided with clean air i.e. charcoal filtered air treatment (F). The response of a popular local rice cultivar, MR-219 to current ambient air pollution of which O₃ is the overwhelming dominant pollutant was investigated for five successive seasons in Muda Irrigation Scheme Area (MADA); the largest rice growing area in Malaysia. The results of the study clearly indicate that at ozone concentrations even lower than the Malaysian air quality guidelines (60 ppb 8 hr mean) level, there exist a significant impact on the growth and yield of the popular rice cultivar MR-219. Even though weeds, diseases, and insect pests were absent, water and nutrients were in abundance, no adverse soil conditions, and that no extreme weather event such as typhoons occurs; the physiological, growth and development performances of rice plants exposed to ambient ozone were found to be significantly ($P < 0.05$) reduced by AOT40 compared to control rice plants in filtered chamber. This study discovered that the root was the most significantly affected component of MR-219 rice plant. Meanwhile, reproductive stage is the most vulnerable period of growth to ozone impact followed by grain filling and vegetative stages, respectively.

Keyword: Air Pollution ; Ground-level ozone ; Open top chamber ; Rice yield ; MADA.