Impacts of Ozone on Fruit and Crop Yield in India

L.under ambient ozone concentration. Being the second largest wheat producing country over 27.81 million ha.area, Indian wheat productivity should thrustout upto 100 million tons per year of wheat by 2020while the actual production is estimated to be ca. 87 million tons per year indicating the significanceof development of crop production (Oksanen et al.,2013).Rajput and Agrawal (2005)while doing experimental analysis with ozone sensitive wheat cultivar reported ozone as the most important air pollutant which leads to 32% yield loss accompanied by blunted seed quality in the most polluted site of Varanasi. Rai et al.(2007) also observed a yield loss of 21% in wheat due to ambient O3 pollution over sub urban area of Varanasi,India. Rai and Agrawal (2014) have already reported about the sensitivity towards ozone of two wheat cultivar of different developmental stages.

Several studies in India have shown that seed and fruit yields are reduced not only under ambient O3 concentrations but also under OTC studies with elevated UV-B radiation. The upraised ozone led to taper growth and net carbon assimilation, impaired gas exchange, reproductive development,harvest index, viability of pollen, activated defense through oxidants,visible injuries and high amount of LPO indicated higher membrane damage accompanied by 9-25% yield losses addressed in these experiments (Ambasht and Agrawal,2003;Rai et al.,2007; Rai and Agrawal.,2008;Mishra et al.,2013;Singh et al.,2014,Sarkar and Agrawal et al, 2010a). Earlier screening base study have examined sensitivity towards the higher O3 concentrations due to higher stomatal conductance, reduction in oxidative capacity and also decline in growth or visible injury symptoms (Biswas et al.,2008a; Singh et al.,2018).

Nagi Reddy et al.,1993 reported that ozone exposure has been shown to decrease the transcription of RuBisCO small subunit genes in potato which is thought to contribute decrease levels of RuBisCO protein which plays a dual role in ozone injury by fixing carbon di oxide during photosynthesis as well as contribute to premature senescence process. However the wide spread occurance of ozone injuries thought to result from the alterations of primary metabolism and carbon allocation, although the biochemical pathways in response to ozone exposure carry differences between insensitive and sensitive plant strains. Despite the C3 monocot plant wheat, C4 Zea mays is also reported to show developmemntal stage related response along with proteome level in the study by Singh et al.,(2014b) at Varanasi,India reported to yield losses for both the two cultivars. Singh et al.,(2014a) represented that higher O3 concentration led to visible injury in the form of interveinal chlorosis, increased manifestation of anthocyanin pigments,reduction in the major photosynthetic proteins, more male flowers and yield losses mainly incase of non quality protein maize than quality protein maize thus concluded better responsive feature of QPM than NQPM in the presence of O3 stress.

Singh et al.,(2018) in Varanasi,India also documented two local maize variety perform better yield and photosynthetic response with the advancement of EDU against high O3 pollution. Although economically it is the 3rd most important crop but researches confined to investigate the chronic effect of O3 over Zea mays are not much documented so far from Asian continent. Palak is a major leafy green vegetable having high contents of folic acid and iron, and is commonly grown in suburban and rural areas, and shown to be very sensitive to O3 (Agrawal et

al.,2003; Tiwari and Agrawal, 2009; Tiwari et al., 2010) Study regarding Dicot C3 plant Beta vulgaris L.var allgreen against urban air pollution at Allahabad city showed decrement in growth, photosynthetic pigment, protein content, ascorbic acid and starch content while experimented by Singh et al.,2005 but they were unable to depict any ozone-specific responses as all of the physiological alteration can appear with the presence of another air pollutants (NO2, SO2 reported).

Tiwari and Agrawal,(2009) in their study observed increment in growth, pigments, yield (23%) on the plant Beta vulgaris var allgreen by the use of antiozonant EDU which acted as support system for the maintenance of the plant physiology against high O3 concentration at Varanasi,India. Tiwari et al.,(2010) in this present study reported the decrement in yield significantly by 23.9 and 28.6 %, in winter and summer palak respectively as O3 seems to play a more significant role in causing greater yield loss of palak during summer season. Biomass and yield reductions were higher in summer than in winter because air quality data reported at the experimental site showed that concentrations of O3 was higher during summer than winter in place of SO2 and NO2. Kumari et al.,(2012) in their study at Varanasi, India stated that Ozone at ambient (50 ppb) and elevated levels (70 ppb)caused negative effects on growth and yield and CO2 enrichment has a fertilizing impact on palak by enhancing the growth and yield (28.6%). Elevated O3 concentration is fetching a menace to the already declining air quality of expanding countries thus crop yield loss assessments are also obligatory in pastoral areas for supporting agriculture.

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