

Pollution and general degradation of the ecology biology essay

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INTRODUCTION

Anthropogenic disturbances, such as growing population and its consequent increasing needs, rapid industrialization, increasing energy consumption and exploitation of the natural resources, have led to a number of negative effects, appearing in the form of pollution and general degradation of the ecology and environment. Cities in developing nations are being industrialized and increasing rapidly in size and diversity. It is accompanied by increasing emissions from vehicular traffic, industry, domestic heating, cooking and refuse burning which pose potential health risk for large scale air pollution exposure. Air pollution kills more than 2.7 million people annually, of which over 90 percent of such deaths occur in developing countries and two-third of these in Asia (UNDP, 1998-Th). Air pollutants not only effect human health adversely but also have serious consequences for agriculture and horticulture crops. The ecological balance is maintained by the plant species as they play an important role in nutrients cycling and also reduce pollutant levels through absorption, accumulation by providing enormous leaf area (Escobedo et al, 2008; P. Suvarna Lakshmi et al., 2008-A. P-6). Ground level ozone is acknowledged to be an important greenhouse gas and most damaging Phytotoxic gaseous air pollutant known to cause serious damage to agricultural crops, trees and natural ecosystems (o3M-12-1, 2), TH-Emberson et al, 2001; Mauzerall and Wang, 2011; Prather et al, 2003). In the stratosphere, ozone is an omnipresent trace gas; it absorbs some of the biologically harmful ultraviolet (UV-radiation) solar spectrum and protects the living organisms from their detrimental effects (o3 M-21). The result of growing anthropogenic activities, the stratospheric ozone is getting

eroded. In contrast, Ground level ozone is build-up in the lower troposphere. During the last two decades, ground level ozone has increased between ~1 to 2% per year (Hough and Derwent, 1990-Th). Ambient ozone is a secondary gaseous pollutant produced photo chemically in the presence of volatile organic compounds (VOC's), carbon monoxide (CO) and nitrogen oxides ($\text{NO} + \text{NO}_2 = \text{NO}_x$) and can accumulate to hazardous levels under favorable weather conditions (o3 M-11-4, 5). Ozone being a key constituent in the troposphere and a strong oxidizing agent, it plays a crucial role in air quality, atmospheric oxidizing capacity and related climate change (O3M-7). The trends in ground level ozone in the urban and rural areas of industrialized regions are strongly linked to the changed in anthropogenic emissions of ozone precursors (o3M-7-USEPA, 2008; Satheesh et al. 2010). Ozone concentration builds up in the atmosphere by several natural and anthropogenic sources. These include (1) downward transport of stratospheric ozone through the free troposphere to near ground level, (2) in situ ozone production from methane emitted from swamps and wetlands reacting with natural nitrogen oxides (NO_x), (3) production of ozone from reaction of volatile organic compounds (VOC's) with NO_x and (4) long range transport of ozone from distant pollution sources (EPA, 1993; Varotsos et al, 2004-o3 M-32). Volz and Kley (1988) have reported that over the past century, the ambient ozone concentration has been more than doubled in the northern hemisphere. In the northern hemisphere, the ambient ozone is basically attributed to the anthropogenic emissions of ozone (O_3) precursor gases (Kelly et al 1984; Penkett 1984; Crutzen, 1988, o3 M-38a). The total amount of ozone is least in the tropics, where it is produced most. But it is

highest in the polar region, where it gets transported from tropics and where the photochemical losses are a minimum (o3M-36). Presently, the industrial sources contribute 20-30% of the tropospheric ozone (O3) column in the tropics of northern Hemisphere and in the southern Hemisphere such contribution is more than that of 10-20% (Lelieveld and Dentener, 2000-Th). In the tropics, Biomass burning is significantly affect the regional and global distribution of ambient ozone as it emits large amount of ozone precursor gases like hydrocarbons (HCs), nitrogen oxides (NOx), carbon monoxide (CO) as well as trace gases like Carbon dioxide (CO2), methane and through long range transport, these can effect distant areas (o3M-17-7, 8, 9, 12). Millan et al. (1996) (o3 M-9) have reported that the ambient ozone concentrations were exceeded recommended levels in all Western European and Mediterranean countries s a consequence of typical photochemical air pollutants and dynamics of the Mediterranean regions. (o3M-13, Dovland 1987; Proyou et al. 1991; Ballaman, 1993; Saitanis, 2003; Riga-Karandinos and Saitanis, 2005). In Asian countries like China, Japan, Korea, Taiwan and Thailand, the ambient ozone concentrations show typically peak concentrations during the afternoon hours in the range of 90 - 200 ppb. (o3M-37). Emberson et al. (2001) reported that in Africa along the Nile delta region, hourly mean ambient ozone concentrations were recorded of greater than 100 ppb. The reliable historical or time series data on ambient ozone are scanty and for India these are practically non-existent. Even though information on Ground level ozone levels is available, it is difficult to compare because of its variation in measurement techniques used by different workers (Volz and Kley, 1998; Hough and Derwent, 1990). Low et al.

(1990) have reported that the ambient ozone level in the troposphere has been steadily increasing since the World war-II. Unlike other air pollutants, problem of ambient ozone is not restricted to any particular air shed but it is consistently regional character. High ambient ozone levels have been reported not only in urban areas but also in many rural areas far away from the industrial and urban areas (o3M-7, Fiore et al., 1998; USEPA, 2008; Satheesh et al. 2010; Th-Wild and Akimoto, 2001; Prather et al., 2003, o3M-38a-9, 12). In India, some short term studies have shown that the ambient ozone levels in urban, peri-urban and rural areas is quite high (o3M-38a, O3M-38, O3M-36, O3M-35, O3M-34, 33, 32). In Delhi, hourly maximum ambient ozone concentration was found to vary between 10 and 273 ppb (Varshney and Agrawal, 1992; o3M-37). Khemaniet et al. (1995) have reported that an annual average daytime ambient ozone concentration was 27 ppb and hourly concentration was 69 ppb at Pune during August 1991 to July 1992 and also the ambient ozone concentration was exceeded 80 ppb at Ahmedabad (lalet et al., 2000-o3M-32). On many occasions, the ambient ozone levels were violated the WHO standard for 1 hour i. e. $110.74 \mu\text{g}/\text{m}^3$ (A. L. Londhe et al., 2008-o3M-38a, O3M-37, O3M-36, Saraf and Beig, 2004-o3M-33, Jainet et al., 2005). Y. V. Swamy et al(2012)(o3M-35) observed the average atmospheric ozone mixing ratios were in the range of 23 ± 8 to 67 ± 13 ppbv. Plant species are very susceptible to the surrounding habitats. Variations in the normal environmental conditions such as wind, temperature, light, nutrients, soil, water content and air pollutants, directly affects the plant physiology functioning like, abnormal symptoms and developing injuries. This injury is often evident on plant species before it can

affect the human beings as well as other animals. (o3M). Over the world wide, the impacts on the plant community has been studies interms of plant environment interactions as the plant species are more sensitive than other organisms (Abbasi et al. 2004, A. P-16). Priyanka and Dibyendu (2009, A. P-16) have stated that the pollutants enter into the plants in a variety of ways and react before being absorbed or removal, that may include accumulation, incorporation into the metabolic system and chemical transformation. During this process, some plant species are injured while other species show minimal effects. The plants response to various air pollutants significantly vary from species to species interms of its reacting mechanisms, type of pollutant and concentration as well as duration of exposure. (Masitha and Pies, 2001; Kleempp et al., 2003; Abbasi et al., 2004; Tripathi et al., 2009-A. P-16). Singh (2003-A. P-16) has suggested that plants can be efficiently used as Bioindicators of pollutants while the sensitive plant species shoeing symptoms if the pollutants are increase in small concentrations at the same time tolerant plants showing no or minimal symptoms. Large number of plant parameters has been used to screen the plants for their tolerance or sensitivity including leaf extract pH, ascorbic acid, relative water content and Total chlorophyll content (Winner, 1981; A. p-1). In India, several studies have been conducted to evaluate the tolerance levels of various plant species in industrial regions (A. P-16, ap-15, ap-14, ap-1, ap-6, 12). The ozone pollution effects on plants were based on mainly field studied limited to identification and description of plant injury symptoms (Th-Middleton et al, 1950). During 1960s and 1970s, the estimates of yield loss by ambient ozone were based on foliar injury surveys. (Th- Benedict et al., 1973; Pell,

1973; Heagle, 1989). During the previous 30 years, numerous attempts have been made to quantify ozone as well as air pollution induced economic losses to agriculture and horticulture crops (Millecan, 1971; Heck et al., 1992, 1986; Heagle, 1989). The first systematic estimation of economic loss from air pollution stress to crops in Los Angeles basin was in the range of \$ 448000 in U. S. (Middleton et al., 1950). Later Millecan (1971) was estimated that ozone and PAN were mainly responsible for 50% and 20% crop loss in United States (U. S.) respectively. Heck et al. (1982) have also reported that an annual crop loss in United States (U. S.) was between 1 to 2 billion dollars by the ozone precursor gases (NO_x, SO_x etc). All these studies have suggested that ambient ozone substantially reduce yield of various crops and causes serious economic consequences (Heck et al. 1982-o3-8, o3-19). In 1980, about 5-6% of gross value of the farm commodities was lost because of ozone pollution (Adams, 1989; Shrineret, 1982). Adams et al., 1989 have suggested that 25% of reduction in ambient ozone levels in U. S. leads to saving of approximately 1. 9 billion dollars annually. In India, several studies have shown the evidences of photochemical reactions by urban primary pollutants leading to the ground level ozone formation and causing severe threat to agriculture production. Bambawale (1986-Th) was recorded primarily the evidences of visible injury on potato leaves due to ambient ozone in Punjab. Test crop plants i. e. mustard (*Brassica campestris* L. CV Pusa Jaikisan), Wheat (*Triticum aestivum* L. Jyoti), spinach and mung bean (*Vigna radiata* L. CV Malviya Jyoti) showed significant reduction in different yield attributes at rural areas having high ozone concentrations (ISEB, 2007-o. p-7). The fumigation experiments results are difficult to extrapolate for

assessing the ambient ozone pollution effects on field grown crops because ozone fumigation schedules were limited only too few hours per day. Ozone severely affects the yield of crops as well as negatively influences the quality of crops. An important aspect of the crop protection is the prevention of crop loss from air pollution. So many studies have proved that ozone has significant effect on agriculture and horticulture crops (o. p-10, ozone-3, 15) in fumigation chambers and field crop studies. As the urban areas are major sources for ozone precursor gases, the local greenery is severely affecting by the photochemical air pollutants. There were limited studies to find the impact of ambient ozone on urban greenery. So, the present study was undertaken to find out the tolerant urban plant species to air pollutants especially ambient ozone and to assess the ambient ozone levels at Hyderabad. The specific objectives of the study were as follows: To monitor Ambient Ozone levels at different urban agglomerations of Greater Hyderabad in various seasons (Summer, Monsoon and Winter) To assess the Air Pollution Tolerance Index of the urban tree species in the study area