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A Review on Emissions and Impact of Gaseous Air Pollutant on Agriculture at Varanasi

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ABSTRACT

This paper deals with the study of emissions and impact of gaseous air pollutants on agriculture at Varanasi. The variation in air quality in terms of Sulphur dioxide (SO2), Nitrogen dioxide (NO2) and around study site were evaluated over the period of 2013-2014 at four sites daring different seasons.

Recent trends have shown decrease in SO2, emissions, but increase in NO2, emission due to more number of automobiles. In past few decades, tropospheric O3, has been identified as a most important air pollutant of a rural areas. Air pollutants produce reactive oxygen species, which adversely affects biochemical processes of plants and reduces their tolerance capacity. An adverse effect caused by air pollutants depends not only upon its concentration, but also on combination of air pollutants. The present review deals with present and future trends of major gaseous pollutants emissions and their impact on crop performance.

Keywords : Reactive Oxygen species, SO2, NO2, Ozone, Crops

I. INTRODUCTION

Air pollution may be defined as any atmospheric condition in which certain substances are present in such concentrations that may produce undesirable effects on man and ecosystem. These substances include gases (SO_X, NO_X, CO, Hydrocarbons etc.), particulate matters (smoke, dust, fumes, aerosols, etc.), radioactive materials and many others. It may interfere with biochemical and physiological processes of plant to an extent. (Heck et al., 1988)

The level of pollutants are rapidly increasing in urban, periurban and rural areas in many megacities of the developing world (Agrawal, 2005). The adverse effects of air pollutant have been associated with three major sources: sulphur dioxide, SO_2 and solid particulates from fossil fuels, photochemical oxidants and carbon monoxide from motor vehicles and miscellaneous pollutants such as hydrogen sulphide, lead and cadmium emitted by smelters, refineries, manufacturing plants and vehicles (Birley and Lock, 1999).

Increased numbers of motor vehicles, power generation, domestic fuel use, refuse burning and other miscellaneous sources contribute to the problem of urban air pollution in India. Plants are the best indicator of pollution (Bonatt, 1997 and Singh, 1998 and Pathak, 2002). Change in stomatal regulation in response to pollution have been studied by Shah et al. 2000 and currently, about 60-70% of acedic rainfall in caused by sulphur compounds and about 30-40% by nitrates. The oxidation processes (ie. Nitrogen, Sulphur Oxides '! Nitric, Sulphuric acids) occur only at higher relative humidity (>70%).

$SO_2+H_2O \rightarrow H_2SO_3$

$SO_3+H_2O \rightarrow H_2SO_4$

$NO_2+H_2O \rightarrow HNO_3$

$NO+H_2O \rightarrow HNO_2$

These reactions are principally controlled by sunlight and temperature. Huge amount of the above pollutants are released every day into the ambient air due to the operation of heavy and light vehicles. Air composition also varies from place to place and time to time. The development progression has customarily been a accompanied by rapid increases in energy demand (Kaygusuz, 2012). Different sources of energy from fossil fuel to pollute the environment in different ways and different levels (Omer, 2008). Presently, energy is largely produced by burning of fossil fuels. Such as coal, oil and natural gas (Veziroglu and Sahin, 2008).

The natural resources have been exploited by the man for meeting his needs. However, the acceleration of exploitation has been increasing at a high rate and in non-judicious manner during past few decades. The environment upon which our life is most depends, has fallen victim of pollution brought by man himself through unplanned and unscientific urbanization, industrialization and mineral exploitation.

By advancement of science and technology, the variety of pollutants is also increasing. This geometrical increase in the rate of pollution has ruined the quality of air, Cooper and Jenkils, Elbir et al. However, scientific study still lacks some essential information about the actual impact of the automobile exhaust and brick industries on surrounding pollution and its management.

MATERIALS AND METHODS

For detailed investigation, the study was conducted in the peri-urban and rural environment of Varanasi located at 25°18'N. 83°24' E. and 76.19 m. above the sea level. It consists of traditional and narrow roads, which ultimately lead to the traffic congestion, during which excess amount of pollutants are emitted by incomplete combustion of fuels. Various study sites are-

Site-1 : Vajidpur, Harahua

Site-II : Chamaun

Site-III : Chaukaghat

Site-IV : Babatpur Airport (Control Site)

Air sample were collected and analyzed using High Volume Sampler (Environment APM- 410) at least six samples were collected at an interval of thirty minutes for ambient air analysis. The concentration of nitrogen dioxide is calculated as follows:

Nitrogen dioxide in

$$\mu gm^{-3} = \frac{\mu gNO_2/mlxV}{Vair\ x\ 0.35}$$

Where,= value from standard curve

V=Total volume of absorbing solution

V_{air} =Volume of air in m^3 (flow rate time)

0.35 Overall average efficiency The concentration of SO_2 is calculated as follows:

Concentration of SO,= $= \frac{\mu gSO_2/mlxV}{Vair}$

Where, $\frac{\mu gSO_2}{ml} =$ ml Value from standard curve

V=Total volume of absorbing solution

V_{air} =Volume of air in m^3 (flow rate time)

With the above mentioned method the concentration of SO_2 and NO_2 at various selected site has been computed.

RESULT AND DISCUSSION

Concentration of SO, and NO, were estimated from the samples of ambient air collected at different sites with regular interval of one month. The result obtained on monthly basis are given in the table:

TABLE – I

Concentration of NO_2 (μgm^{-3}) in ambient air at different study sites in Varanasi

Month	Brick Industry Site		Road Site	Control Site (Babatpur Airport, Varanasi)
	Site I	Site II	Site III	Site IV
May 2013	30 ± 3.65	25 ± 1.56	94 ± 1.01	16.16 ± 2.04
June	27 ± 1.54	22 ± 1.32	25 ± 1.42	16.00 ± 1.00
July	-	-	61 ± 1.30	-
August	-	-	41 ± 1.21	-
September	-	-	50 ± 2.51	-
October	-	-	51 ± 1.61	-
November	23 ± 2.54	20 ± 1.54	60 ± 3.20	15.13 ± 0.68
December	35 ± 3.76	31 ± 2.76	68 ± 1.65	15.62 ± 0.39
January 2014	34 ± 1.49	30 ± 4.54	61 ± 1.21	15.63 ± 1.00
February	32 ± 4.90	28 ± 2.00	62 ± 1.62	15.99 ± 0.39
March	30 ± 2.67	27 ± 1.65	69 ± 2.36	16.00 ± 0.98
April	31 ± 1.58	30 ± 1.74	79 ± 3.78	16.23 ± 1.98

± = Standard Deviation.

TABLE-II

Concentration of SO_2 (μgm^{-3}) in ambient air at different study sites in Varanasi

Month	Brick Industry Site		Road Site	Control Site (Babatpur Airport, Varanasi)
	Site I	Site II	Site III	Site IV
May 2013	30 ± 3.65	25 ± 1.56	94 ± 1.01	16.16 ± 2.04

June	27 ± 1.54	22 ± 1.32	25 ± 1.42	16.00 ± 1.00
July	-	-	61 ± 1.30	-
August	-	-	41 ± 1.21	-
September	-	-	50 ± 2.51	-
October	-	-	51 ± 1.61	-
November	23 ± 2.54	20 ± 1.54	60 ± 3.20	15.13 ± 0.68
December	35 ± 3.76	31 ± 2.76	68 ± 1.65	15.62 ± 0.39
January 2014	34 ± 1.49	30 ± 4.54	61 ± 1.21	15.63 ± 1.00
February	32 ± 4.90	28 ± 2.00	62 ± 1.62	15.99 ± 0.39
March	30 ± 2.67	27 ± 1.65	69 ± 2.36	16.00 ± 0.98
April	31 ± 1.58	30 ± 1.74	79 ± 3.78	16.23 ± 1.98

± = Standard Deviation.

Analysis shows that the site I (Brick Industry site) was the most polluted site. This brick industry has a high kiln capacity i.e. 35000. bricks are produced in a day i.e. 3500 more than that of the brick industry at site II, due to low stack height at site I.

Sulphur dioxide concentration in the stack was found to be in between 195.31 to 225.38 (μgm^{-3})at site I whereas 96 to 187 (μgm^{-3}) at site II. In July, August, September & October (2013) due to rainy season, all the brick industries were found to be non-functional. This may be the major factor for appearance of low level of pollutants in ambient air. During these four months, the wind rose was also more or less symmetrical. (Yadav et.al., 2006).

At road site with vehicular movement was found to be ranging from 41 to 23 (μgm^{-3}) at site III which is higher than that of control site IV due to slow moving vehicles and clumping of tall buildings and poor ventilation in some areas. (Pandey, 2005)

Similarly concentration of NO_2 in the stack was found to be in between 23 to 35 (μgm^{-3}) at site I whereas 20 to 31(μgm^{-3}) at site II. At the road side with vehicular movement was found to be ranging from 41 to 94 (μgm^{-3}) which higher than that of control site IV.

Pollution load in the ambient air of brick industry study site I and II was much higher as compared to the control site IV, similar observation were also observed by Singh et al. (2003) and Matkoric and Juretic.

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