



INTRODUCTION

CHAPTER – 1 INTRODUCTION

The earth is the only planet known in the entire universe capable of supporting life. This property of earth is due to its unique atmospheric layer enveloping it. Instead of better living standard we need clean air, pure water; nutritious food clothes and space etc. which are basic amenities of life. Normal air contains about 78% nitrogen, 21% Oxygen, 0.93%, argon 0.038% carbon dioxide, and several other trace gases. Changes in the gaseous composition of earth's atmosphere have become a prime concern for today's world due to human activities. Air as we all know is most essential for life. It has been established that man can hardly survive for 5 minutes without air. However we can survive for 5 days without water and 5 weeks without food. Inhaling impure air is almost to not inhaling air.

“Air pollution may be broadly defined as the presence of one or more contaminants like dust, smoke, mist, in the atmosphere which are injurious to human beings, plants and animals or which unreasonably obstruct the comfortable enjoyment of life and property. “More than 100 contaminants have been identified in atmosphere .Some of them are known as primary pollutants such as CO₂, CO, NO_x, SO₂, SPM, RSPM etc. those which are directly emitted from the source and the another category is of secondary pollutants that are formed by the further reactions of the primary pollutants in the atmosphere such as O₃, PAN (Peroxy acetyl nitrate), and photochemical smog.

The ambient environment of an urban area may be contaminated with several pollutants such as SO₂, CO, NO_x and the plants growing there would be exposed not only to one but many pollutants and different conditions. Ambient air pollution in several large cities of India is amongst the highest in the world (Agarwal, 2005). Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or cause damage to the natural environment or built environment, into the atmosphere. The atmosphere is a complex dynamic natural gaseous system that is essential to support life on planet

earth. Stratospheric ozone depletion due to air pollution has long been recognized as a threat to human health as well as to the Earth's ecosystems.

The particulates and gaseous pollutants, alone and in combination, can cause serious setbacks to the overall physiology of plants (Ashenden and Williams, 1980; Mejstrik, 1980; Anda, 1986). It has been an established fact that plants are 'living filters', leaves and exposed parts of a plant generally act as persistent absorber in a polluted environment. Plants provide an enormous leaf area for impingement, absorption, and accumulation of air pollutants in the environment (Warren, 1973; Shannigrahi *et al.*, 2004).

Air pollutants like SO₂, NO_x, SPM, and RSPM are responsible for reduction of biological and physiological responses of various plants and crops grown at polluted area (Joshi and Chauhan, 2008; Chauhan and Joshi, 2008). Growth inhibition in crops has been observed by exposure to SO₂, NO_x, SPM, RSPM and severity varied widely with crop species and pollutant dosage (Ormord, 1984).

It is well known that air pollutants bring about qualitative change in the metabolic system which eventually may affect the production capacity of crops. Crop losses caused by air pollution have to be taken seriously on account of social and economical implications. The effect of air pollution on crops in general is a function of the environment as well as edaphic condition. Crop yield reduction due to air pollution in developing countries may have major implication for food security, nutrition and economic output. Clearly this results of biomass and yield gives the impact of air pollution on crop in field condition.

The decreases in such parameter i.e. quality of crops are correlatable to the increase in the total pollution load (McLeod *et al.*, 1988). Crop production is highly dependent upon environmental condition among which air quality can play a major role. Maggs *et al.* (1995) have further shown significant reductions in various yield parameters of both wheat and rice near Lahore at annual mean nitrogen dioxide (NO₂) concentrations of 20–25 ppb and 6 h mean O₃ concentrations reaching 60 ppb in certain months. In both cases the effect was attributed primarily to O₃.

The effect of air containing hazardous matter varies with chimney height, climatic factors, topographic layout, and wind direction and speed. The sensitivity of

plants to heavy metal depends on interrelated network of physiological and molecular mechanisms. Heavy metals are major environmental pollutant, which are discharged into the atmosphere from the burning of fossil fuels, release of industrial wastes and use of agrochemicals. Heavy metals and metalloids make a significant contribution to environmental pollution as a result of human activities such as emissions from automobile, mining, smelting, electroplating, energy and fuel production, power transmission, intensive agriculture, sludge dumping and military operations (Nedelkoska and Doran 2000).

The proposed research work is framed monitoring for and analysis of the four main air pollutants which are generally covered in air quality survey, i.e. Repairable Suspended Particulates matter (RSPM), Sulphur Dioxide (SO₂), Nitrogen Oxides (NO_x), & heavy metal at Pithampur Industrial Area to assess the present air quality status and to compare it with quality of air existing before this experimental work and to have an assessment of the air quality status in future. The research work also observes the effect of air pollution on plants and crops. Some of the plant indicators used to study the quality of air at different sectors at Pithampur. Regional Office of M.P. Pollution Control Board conducts the ambient air quality monitoring work. Above work is done with the help of M.P. Pollution control board, regional office Vijay Nagar, Indore. Present study is concerned with ambient air quality affected crop and plants; including ambient air quality monitoring, heavy metal estimation and biochemical studies.

1. 2. AIMS AND OBJECTIVES:

The specific objectives of the present study are as follows –

1. To study ambient air quality monitoring (AAQM) at the three different site of the three sectors of Pithampur industrial area.
2. To compare the AAQM of previous years and the recent years.
3. To study the effect of air pollution on field crops and APTI Index of leaves and protein content, carbohydrates of seeds.
4. To study of other pollutants like heavy metals, effects on protein content of plants leaves etc.
5. Bio-monitoring of air pollution with the help of some plant indicators.
6. To study and suggested control measures of air pollution on the basis of present study.

REFERENCES

- Ashenden T.W., Williams I. A. D. (1980).** Growth reduction in *Lolium multiflorum* Lam. and *Phleum pratense* L. as a result of sulphur dioxide and nitrogen dioxide pollution. *Environmental Pollution*. 21: 131-139.
- Anda A. (1986).** Effect of cement linn dust on the radiation balance and yields of plants. *Environmental Pollution*. 40: 249-256.
- Agrawal M. (2005).** Effects of air pollution on agriculture: An issue of national concern. *National Academy of Science Letter*; 23(3&4): 93-106.
- Chauhan A. (2008).** Effect of automobile and industrial air pollutants on some selected tree grown at the edge of road side in Haridwar. *Journal of Natural & Physical Science*. 22(1-2): 37-47.
- Chauhan A., Sanjeev. (2008).** Impact of dust pollution on photosynthetic pigments of some selected trees grown at nearby of stone-crushers. *Environment Conservation Journal*. 9(3): 11-13.
- Mejstrik V. (1980).** The influence of low SO₂ concentration on growth reduction of *Nicotiana tabacum* L. W. Samsun and *Cucumis sativus* L. cv Unikat. *Environmental Pollution*. 21: 73-76.
- McLeod A.R., Baker C.K. (1988).** The use of open field system to assess yield response to gaseous air pollutants. In: Assessment of crop loss from Air pollutants. W.W. Heck O.C. Taylor and D.T. Tingey., Eds. *Elsevier Applied Science, New York*. 211-224.
- Maggs R., Wahid A., Shamsi S.R.A., Ashmore M.R. (1995).** Effects of ambient air pollution on wheat and rice yield in Pakistan. *Water Air Soil Pollution* 85: 1311-1316.
- Nedelkoska T.V. and Doran P.M. (2000).** Characteristics of heavy metal uptake by plants species with potential for phytoremediation and phytomining. *Minerals Engineering*. 13: 549-561.
- Ormrod D.P. 1984.** Impact of trace element pollution on plants. In: Air Pollution and Plant Life (Treshow M, ed). 291-319, Wiley, Chichester, UK.
- Shannigrahi A.S., Fukushima T., Sharma R.C. (2004).** Anticipated air pollution tolerance of some plant species considered for green belt development in and around an industrial/urban area in India: An overview. *International Journal of Environmental Studies*. 61(2): 125-137.
- Warren J.L. (1973).** Green space for air pollution control. School of Forest Resources, *Technical Report No. 50*, North Carolina State University, Raleigh, North Carolina.

1.3. STUDY AREA



Pithampur is a town in the Dhar district of Madhya Pradesh, India. Governed by Nagar Nigam, it is a well-known industrial estate referred to as the 'Detroit of India'. Pithampur is located at a distance of about 22 km from Indore via Rau and is 8 kilometers from Mhow and A.B. road (NH-3), which is another suburb of Indore.

1.4. Geography:

Pithampur is located at a latitude $22^{\circ} 37'27''$ N and longitude $75^{\circ} 34'58''$ E at the east central border of Dhār District in M.P. about 45 km from Indore altitude is about 550 meter above mean sea level. Pithampur is located about 16 km away from A.B. road NH-3.

1.5. Climate:

As per the data available in the Regional Meteorological Office, it is towards south-west in the month of July and June and towards north-west in the month of April and May. In post monsoon the wind flows predominantly from North-east quadrants. March to May is the hot month followed by the monsoon from June to September. October and November may be termed as post monsoon where as the winter is from December to February.

1.6. Temperature:

The daytime temperatures can touch 40°C on more than one occasion. Average summer temperature may go as high as 36–39 °C (100.4 °F) but humidity is very low. Winters are moderate and usually dry. Lower temperatures can go as low as 14°C-16°C on some nights. Usually the temperature ranges between 26°C-30°C during winters.

1.7.Rainfall:

Average rainfall is about 900 mm about 90% of the annual rain fall is received during monsoon. The source of surface water is Sanjay Reservoirs and Karan Reservoir. The other of surface water is river Chambal which is approximately 72km from Pithampur and Bagdun and Alwar Lake.

1.8. Industrial Connection:

Pithampur is the first largest industrial area in Asia. Pithampur is a well-developed industrial area. It has both large and small scale industries. A large number of national and international reputed companies are functioning in Pithampur. It has divided mainly in four sectors; sector-I, II, & III. Pithampur has an industrial Special Economic Zone (SEZ). Majority of the vehicle-producing companies of India have their factories in Pithampur. It is considered as a hub for the automobile manufacturing industry. Some of the major companies that have industrial units in Pithampur are (New & Recon Parts, Cummins, India), (Mahle Engine Components (I) Pvt. Limited), Flexituff International Limited, Anant Steel P. Ltd., L&T CASE Equipment, Eicher Motors, Mahindra 2 Wheelers, Caparo, Force Motors Ltd, Man Force Trucks, Rathi steel, cipla, Indorama Synthetics, Steel tubes of India, Bridgestone Tyre Ltd, Kach Motors, IPCA, Lupin, Syncom, Decora Tubes. The construction of Asia's largest auto testing track is also sanctioned by Govt. Of India. Apart from automobile industries, Pithampur is home to various other industries like food processing, chemical processing, distilleries, manufacturing, and textile industries.

Pithampur has a Dry Port facility from Container Corporation India Limited. This facilitates direct exports of finished goods to foreign countries with all paperwork done at Pithampur facility.

Followings are details of industries in different sector of Pithampur Industrial area

Sector-I

Name of industries	Products
Aluminium Sheet Metal	Aluminium Utensils
Bhagiruth couch	Eicher Body
Crompton Greaves	Railway Signaling Unit
Desingh Auto	Head light, Bulb Production Vehicle
Force motors	Mini car, Zeap
Him Teknoforge,	Forging for Automobiles & Engineering's
Hindustan Phosphates	Dicalcium Phosphate
Indore Composite	FRP cable
Jaya Hind Industries Ltd.,	Tempo, Trax, Metadors
J.K. Files & Tools Division	Raymond Ltd., Files Products
Jyothy Laboratory	Detergent Powder
Kach Motors Pvt. Ltd.	Bright Bars / Wire Shot
Lamp cap India Ltd	Bulb Cap
Man Saw Pipe	Iron pipe
Mahindra 2 Wheelers	Two wheelers assembling
Mahle magma	Cam Shaft & Valve Tappets
Man Industries India Ltd.	Aluminium Section
Man Aluminium Ltd	Aluminium Profiles, Saw Pipe, Spire Pipe
Medicaps Limited	Empty Hard Gelatine Capsuls
Medilux Laboratory	Basic Drugs & Fine Chemicals
Neo Corp International	Packaging Unit
Pinnacle Industries Ltd	Seats
Porwal Auto Components Ltd.	CI Castings SG Casting
Rajratan Global Wire	Steel Wire, Tyre Bead Wire
Rosy Blue	Diamond Cutting
Sanctus Drugs & Pharma Pvt. Ltd	Pharmaceutical
Shreyas Auto Engineering (P) Ltd	Automobiles Parts Mfrs
Synthochem	
Unichem Laboratories Ltd	Laboratories
VE Commercial Vehicle	Gear Box Assembling

Sector –II

Caparo unit – I	Sheet Metal Component
Caparo Unit- II	Long Member
Indo Borax & Chemicals	Boric Acid Powders / Granular, Borax
IPF Vikram	Detergent & Soaps
Kirti Industrial	Railway Job Work, Steel Job Works
M.P. Waste Management Project	(Incinerator) Hazardous waste Disposal Site
Madhya Pradesh Metal Powders	Aluminium Powder, Pyro, Aluminium Paste.
Mahima Purespun	Cotton Yarn
Nicholas Labs	Formulation Life Saving Medicine
Piramal Healthcare	Pharmaceutical
Parag Copy graph Ltd	Carbon Less Paper / Fax Paper
Silver Oak India Limited	Bleding & Bottling
Shiva Detergent	Detergent
Sonic Biochem Extraction	Soya Products
Vikram Urethane (P) Ltd.	Mfrs. of Detergents & Soaps
Worth Peripherals (P) Ltd	Peripheral

Sector- III

Anant Steels (P)	Tor, Steel Bars
Avtec Ltd. (PUP)	Contessa, Ambassador, Lancer, Tractor, Ford, GM
Bridge Stone	Tyre
Bharat Petroleum Corp. Ltd.	Bottling of LPG Cylinder
Cipla	Pharmaceutical/ Basic drugs
Cummins Turbo Technologies	Core Assembly for Law MVH
Dabur India	Hair oil, Tooth past
Divya Jyoti Industries Ltd.,	Soybean Oil
Flexi tuff international Ltd	HDPE/PP, Woven Sacks
Girnar Fileer	100% Cotton yarn
Glenmark Generics Ltd.	
Gujarat Ambuja Exports Ltd	Soya Solvent Extraction Oil & Cake Flour
Innovative Clad Solutions Pvt. Ltd.	Pharma Products

IPCA	Pharmaceutical
Kesar Alloys and Metal Pvt. Ltd.,	M.S. Ingots
Lloyd Insulations (India) Ltd.	Supercera Fibers & Polyurethanes
Kisliya Herbal Ltd	Tannic Acid, Herbal Dry Extats
Lupin	Pharmaceutical
L & T	Equipment/ Engineering unit
Liugong India Pvt. Ltd.	Earthmoving Equipment
MID Indain	Steel Work
Mittal Appliances Ltd.	Aluminium Utensils
Mission Vivacare Limited	Formulation, Pharmaceutical Product
Mohta Cement	Port land Cement
Mylan Lab	Laboratories equipment
Pluton cement Pvt. Ltd.	Cement
Polyport Cement (P) Ltd	Port Land Cement
parasram Puria Internationa	Synthetic Fibre Yarn
Panasonic Energy India Co. Ltd.	Dry Battery Cell (Novino)
PEB Steel Lloyd (I)	Steel
Prakash Solvex	Soybeans Extraction Plant/Refinery
Pratibha Syntex	Cotton yarn & Fabrics
Rit Spin	Cotton yarn
Rohit Surfactants (P) Ltd.	Detergent Powder & Cake
R.S. Electrical Pvt. Ltd.	Tungsten Filaments
Rathi Iron & Steel Industries Ltd	Iron & Steel Product
Sanchi Organics (P) Ltd.	Dyes & Dyes Intermediate
SRF Limited. (Unit-II)	SRF Packaging Files Business
Shikhar Sai Oils Pvt. Ltd.	Oil Extraction
Symbiotic	Pharmaceutical/ Basic drugs
Spentex	Spindle, Cotton yarn
Shri Paper Product India	Paper Cone
Sanchi Organics	Dyes & Dyes Intermediate
Sanchi Chemicals	O.S. Dyes & Dye Intermediate
Tata Wire	Wire
TGW Machine Knives	Instrument Machine manufacture
Triveri Shiston Conductors Ltd.	Super Enamelled Copper Wires Insulated Submersible Winding
ZYG Pharma Pvt. Ltd.	Creams Ointment

1.9. Population:

As a census of India 2001, Pithampur had a population of 68,051. Males constitute 58% of the population and females 42%. Pithampur has an average literacy rate of 62%, higher than the national average of 59.5%, male literacy is 73%, and female literacy is 47%. In Pithampur, 18% of the population is under 6 years of age.

1.10.Connectivity:

1.10.1. Air connectivity: Nearest airport is Devi Ahilyabai Holkar Airport at Indore which is about 19KM or 40 minutes drive from Pithampur, with multiple daily connections and operators to Mumbai, Delhi, Ahmadabad, Hyderabad, Nagpur, Pune, Bangalore, Kolkata, Jaipur, Bhopal, Raipur, and Gwalior.

1.10.2. Road connectivity: Pithampur is located on NH-79, and NH-59 connecting Indore with Ahmadabad touches its fringes. There is a road from Rau to Pithampur which connects it to Indore (22KM). It is also connected to Agra-Mumbai 4 lane road which is also referred to as NH-3 and also with a new route to Bombay.

1.10.3. Train connectivity: The nearest railway stations are MHOW (11 km) and Rajendra Nagar which is a part of Indore (22 km). Mhow and Rajendra Nagar are Meter Gauge Railway stations with limited connectivity to nearby areas whereas Indore railway station (INDB) is Broad Gauge Terminus. Indore terminus has good connectivity and daily connections to all metros and all major towns of country and the state. The new proposed and sanctioned railway line between Indore and Dahod will traverse the Pithampur area and will connect the region directly to Indore and Godhra-Dahod-Vadodra in Gujarat, boosting industrial development. Also Pithampur is well-known historical city in Madhya Pradesh. There are regular scheduled Mini bus/City Bus/Private Bus services between Indore and Pithampur passing through Mhow throughout the day with a very good frequency. Also there are regular services to District Headquarter Dhar and beyond to Ratlam:

1.10.4. Selection of sampling stations:

To study the effect of industrial air pollution in major Pithampur industrial areas, a preliminary survey was carried out. On the basis of industrial area,

availability of monitoring facility and common plants species and major crops three sampling sites were selected and categorized as under following sectors.

1. Sector-1
2. Sector- 2
3. Sector-3

The 4th one was control site selected far away from industrial area as non-polluted Patthar Mundla, Village Palda, Indore, which was purely agriculture area as village having good environmental condition for plants, animals as well as human beings.