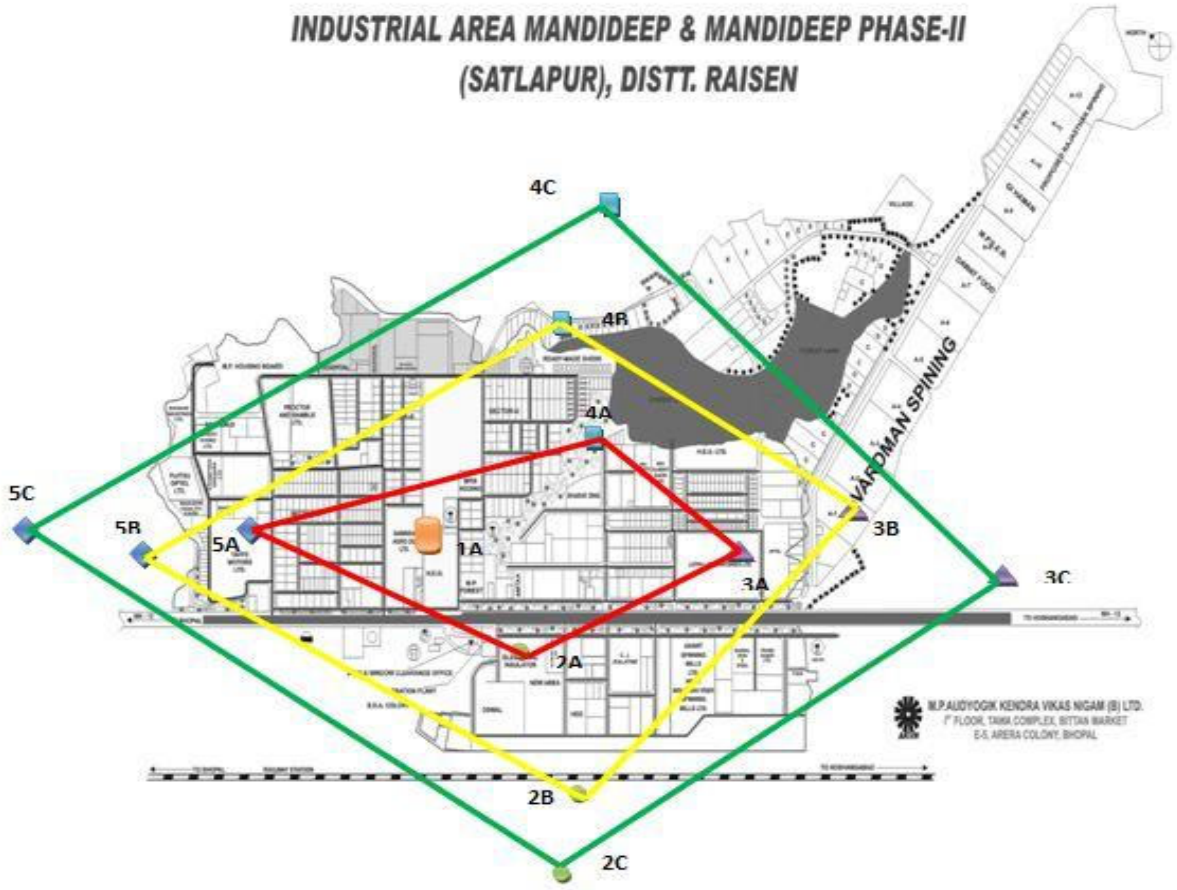
Presence Of Heavy Metals In Vegetation
&
Their Effects



2011-12

Central Pollution Control Board
Zonal Office (Central)
Bhopal

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Report

On

Presence Of Heavy Metals In Vegetation & Their Effects

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Zonal Office (Central)
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Executive Summary

The Mandideep Industrial Area having industries like Electro graphite, fabrication (steel & wooden), paints, pesticides formulation, bulk drug & pharmaceuticals, steel & aluminium rolling units, epoxy casting, electrical insulators, battery, food processors, plastics, transformers, detergents, soft drinks, gelatin, thermal power plant, recycled paper, spinning, weaving/dyeing was chosen as the effluent generated during process & utility is being discharged in river Betwa, a tributary of river Yamuna. This industrial area also doesn't have CETPs to treat the industrial waste. To study the presence & accumulation of heavy metals (Pb, Cd, Ni, Cu, Zn & Cr) in water, soil and vegetation (grass) of Mandideep sampling was done in and around(200-1000 metres) of the Mandideep Industrial area in all the four directions with reference to the distance from industrial clusters.

The effluent & sewage generated from Mandideep industrial area finally meets River Betwa. The heavy metal analysis report states that river Betwa is free from toxic heavy metal (Pb, Cd, Ni, Cu & Cr) contamination however the Zn concentration was observed, that is also below the lethal concentration as per the drinking water quality standard *(IS-10500-1991)* the desirable limits of Zn is 5 mg/l (max). The water pollution at *D/s* & *U/s* of river Betwa may be due to stagnancy or lean flow of river water along with the religious activities at the river bank. In between the Mandideep Industrial Area the bio-monitoring was not carried out due to stagnant water body with zero dissolved oxygen.

The availability of minerals as micro & macronutrients is very much necessary for the plant metabolism & healthy growth. The mineral ion concentration in tissue that reduces the dry weight of tissue by about 10% is considered toxic to the plant. The presence of these toxic mineral metals (Pb, Cd, Ni, Cu, Zn & Cr) studied under this project states that Mandideep industrial area has no visible as well as analytical presence of Pb, Cd & Cr in its soil & plant species (*Cynodon dactylon*). However, the presence of heavy metal Ni (2-25mg/kg), Cu (5-35mg/kg) & Zn (25-45mg/kg) was analysed and found beyond their required concentration (less than 10mmol per kg of dry matter) in grass (*Cynodon dactylon*). The uptake of Ni, Cu & Zn is carried out mainly by root systems via passive & active transport & seems that all three soluble metals absorb through the same transport system. The uptake of Cu^{+2}, Ni^{+2}& Zn^{+2} is competitive in nature. Results states that the Zn concentration is higher than Cu & Ni in grass of every sampling direction suggest the competitive transport system. The higher concentration of Zn in grass may also be due to availability of Zn mineral in soil.

Further a long term study can enhance the cause of presence of heavy metals & their effects on the vegetation.

List of abbreviations

DO	:	Dissolve Oxygen
U/s	:	Upstream
D/s	:	Downstream
BMWP	:	British Biological Monitoring Working Party
BWQC	:	Biological Water Quality Criteria
NRCP	:	National River Conservation Plan
HEG	:	Hindustan Electro Graphite
P&G	:	Proctor and Gamble
AAS	:	Atomic Absorption Spectrophotometer

Presence of Heavy Metals in Vegetation & their Effects

1. Introduction:

Industrial waste/effluents of large number of pollutants in higher concentration generates through chemical industries, metal processing, electroplating, pharmaceuticals, distilleries, fertilizers, pesticide industries & others are a major source of groundwater, surface water & soil pollution. The free of cost availability of effluents for irrigation purpose makes it a common practice throughout the country. Studies states the suitability of treated effluent in irrigation **(Somashekar et al., 1984; Hariom and Arya, 1994)**, however on the other hand research studies have reported the adverse effect of treated effluents on crops **(Goel and Kulkarni, 1994; Khan and Jain, 1995; Pandey et al., 2002).** Accumulated large variety of chemicals & heavy metals makes the nearby industrial area a sink of pollutants/heavy metals **(Pandey and Srivastava, 2002).**

Heavy metals pose harmful & severe ill effects on aquatic life, plant growth as well as the human health. Metals with a density higher than 5g/cm^3, defined as heavy metals. Out of 90 naturally occurring elements 53 are heavy metals. Based on the solubility under physiological conditions, 17 heavy metals are of importance for organism & ecosystems **(Weast, 1984).** Sixteen chemical elements are known to be important to a plant's growth and survival. Out of 16 chemical elements, 13 are classified as mineral & 03 as non-mineral (Hydrogen, Oxygen & Carbon) elements. The 13 minerals further classified as macro (06) & micro (07) nutrients. The macronutrients as per their availability in soil & essentiality for plant growth are classified as primary (Nitrogen, Phosphorus & Potassium) & secondary (Calcium, Magnesium & Sulphur) macronutrients. The micronutrients required in trace amount are Boron (B), Copper (Cu), Iron (Fe), Chloride (Cl), Manganese (Mn),

Table no. 01: *Morphological symptoms in plants due to mineral deficiency*

Elements	Deficiency Symptoms
Nitrogen	Stunted Growth; Chlorosis
Phosphorus	Poor growth, leaves dull green
Potassium	Yellow edges to leaves; Premature death
Calcium	Stunted growth
Magnesium	Chlorosis
Sulphur	Chlorosis
Iron	Chlorosis
Manganese	Chlorosis; grey spots on leaves
Molybdenum	Slight retardation of growth
Boron	Brown heart disease
Copper	Diebacks of shoots
Zinc	Malformed

Molybdenum (Mo) & Zinc (Zn). Deficiency symptoms of these minerals *(Table no. 01)* can be visualized morphologically at plant parts: leaves, stems & roots.

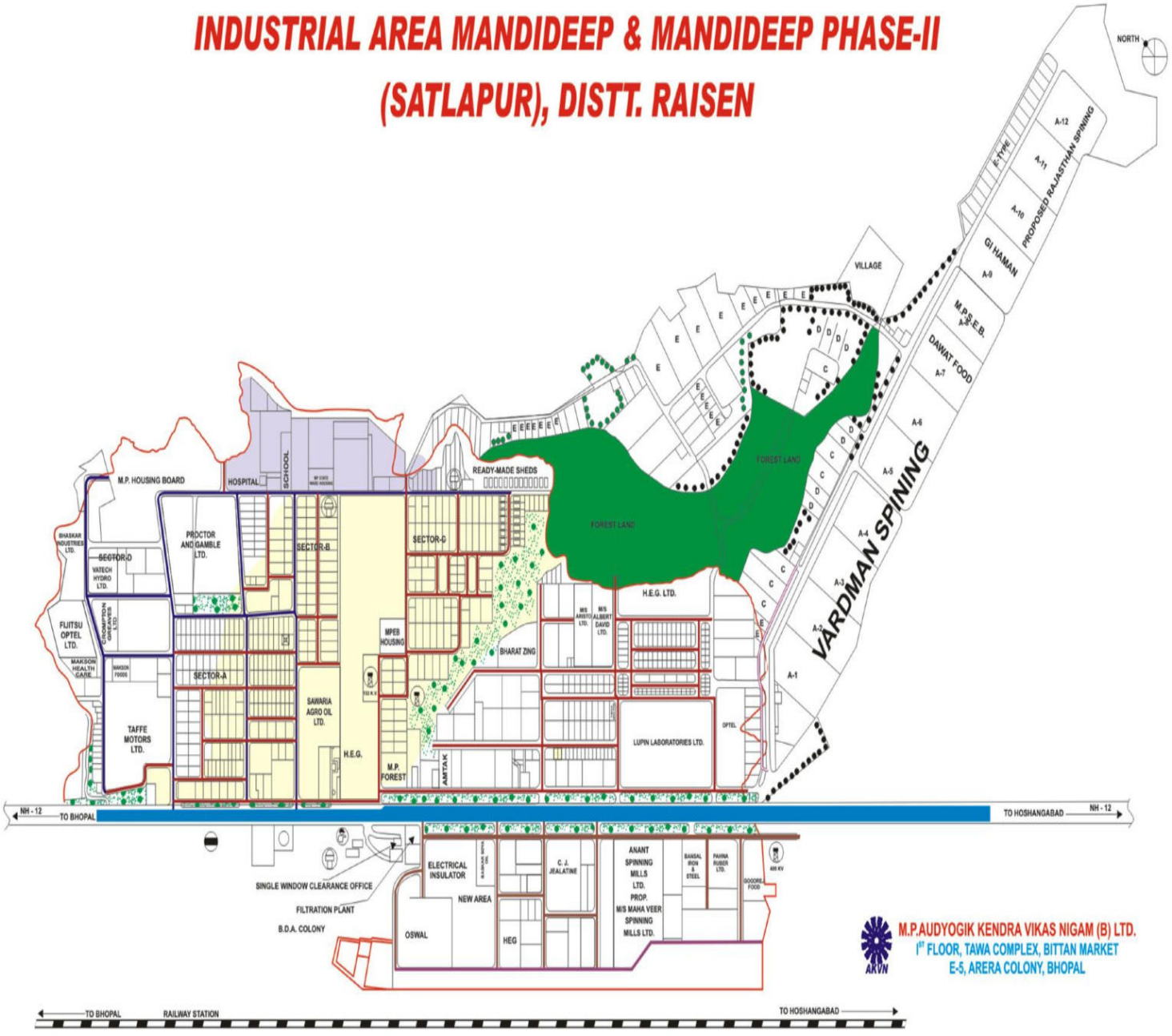
Heavy metals Arsenic (As), Mercury (Hg), Silver (Ag), Cadmium (Cd), Lead (Pb) & Uranium (U) have no known function as nutrients and seem to be more or less toxic to plants and micro-organisms **(Breckle, 1991; Nies, 1999).** Excess concentrations of these toxic heavy metals decrease growth rate of plants by affecting root metabolism. The high concentration of heavy metals in soils is reflected by higher concentrations of metals in plants and consequently in animal and human bodies. The reported abdominal pain, irritability, joint pain, anemia, kidney damage, gastrointestinal disorder, bone diseases, dermatitis, pulmonary cancer, ulcer are few severe impacts of these metals. The carcinogenic & neurotoxic affects of these metals makes them more lethal to human beings.

The plant species grown nearby the contaminated sites or effluent drains absorb & accumulate the pollutants/metals and indicate the environmental pollution. Plants are the pathways to move these heavy metals from water to human beings. Bioaccumulation of metals adversely affects the plant growth and metabolism. Stunted growth, chlorosis, necrosis and discoloration are few symptoms of phytotoxicity.

To study the geographical and temporal distribution of pollutants; Pine, Mosses and Grasses are widely used as specific pollution indicator. The chemical exchange between soil & plants has been classified in three categories to assess the metal toxicity to plants from soil e.g.

1. Presence/absence of bio-indicator species
2. Metal concentration in the tissues of selected bio-indicator species
3. Physiological & biochemical responses in sensitive bio-indicator species

To study the presence and accumulation of heavy metals (Pb, Cd, Ni, Cu, Zn & Cr) in vegetation near the industrial area near to Bhopal (Madhya Pradesh). Mandideep Industrial area established in year 1975, situated 25 Km away from Bhopal was identified and selected for the above study. Hindustan Electro Graphite (HEG) was the first industry of Mandideep.



Proctor and Gamble (P&G), LUPIN Laboratories, TAFE Tractors, Godrej Foods, Insulator and Electrical are few names of industries operational at this industrial area. More than 700 units situated in about 1100 hectares area. The Industrial Area of Mandideep is developed as Sector A to D, Mandideep New, New-I, New-II & Phase-II. Electro graphite, fabrication (steel & wooden), daal mills, paints, pesticides, fertilizers, pharmaceuticals, steel &

aluminium rolling units, epoxy casting, electrical insulators, battery, food processors, PVC/HDPE/LDPE plastics, transformers, chemicals (Sulphonic acid, Sodium chloride, Sodium sulphide) are few kinds of industrial development at Mandideep Industrial Area. The effluent generated during process & utility is being discharged in river Betwa, a tributary of river Yamuna. River Betwa arises in the Vindhya Range, Jhiri village of Hoshangabad in Madhyapradesh flows near the Mandideep Industrial Area. 573 Km long river meets Yamuna River near Hamirpur (Uttar Pradesh). Due to effluent discharge, River Betwa has been selected by the National River Conservation Plan (NRCP) for cleaning and pollution control.

To study the impact of heavy metals on aquatic life of river, biomonitoring was also carried out at Upstream (near village Mundela), In between the Mandideep Industrial area & Downstream (near Bhojpur, Shiva temple).

2. Methodology:

To study the presence & accumulation of heavy metals in water, soil and vegetation (grass), the Mandideep Industrial Area was monitored by Central Pollution Control Board, Zonal Office, Bhopal during FY 2011-12. To acquire information on heavy metal contamination throughout the Mandideep, sampling was done in the industrial area, far (200-300 metres) from the industrial area & very far (500-1000 meters) from the industrial area in all the four directions with reference to the distance from industrial clusters. In each direction, 3 samples (in, far & very far) of water, soil & plant (grass) each were collected along with a sample collected from the centre of Mandideep area (M/s Sanwaria Agro Oils Ltd). In this way total 13 (4x3+01) samples of water, soil & grass each were collected for the analysis of heavy metals (Pb, Cd, Ni, Cu, Zn & Cr). Three water samples at identified locations of river Betwa were also collected to analyse the concentration of metals.

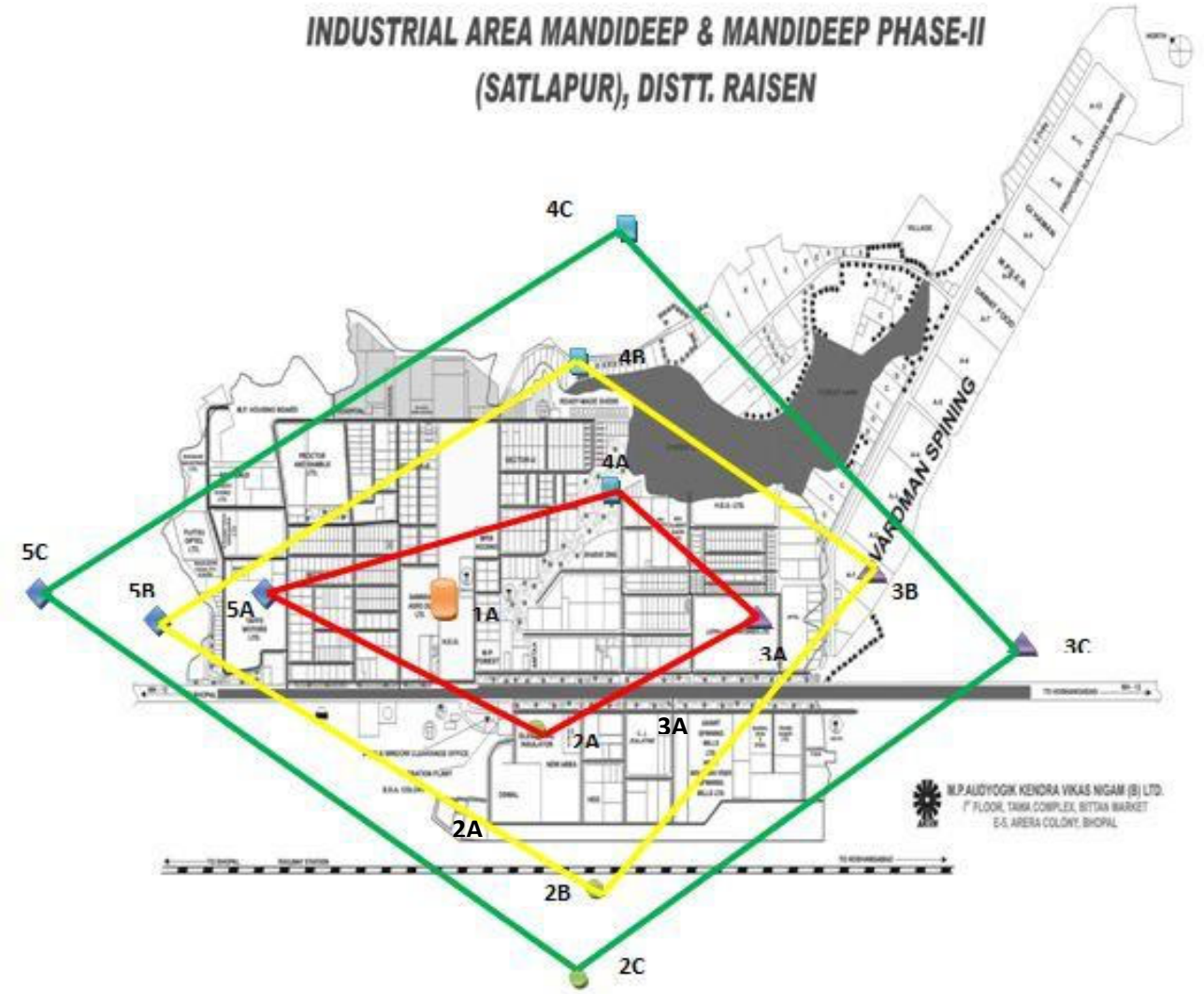
Studies have shown that perennial grasses are high accumulator of heavy metals as well as the reducer of metal-toxicity and are characterized as high dry matter producer. Grass as cheap fodder for animal husbandry has the risk of toxicity on consumption. For the estimation of heavy metal content & its accumulation *Cynodon dactylon* (Dooba grass) was chosen as sample of vegetation.

To evaluate the water quality of River Betwa, in view of diversity score of benthic macro-invertebrates a biomonitoring was also carried out at the upstream (near village Mundela), In between Mandideep industrial area & downstream (near Bhojpur, Shiva temple).

To identify the bio-indicator species along with the morphological changes occur due to heavy metal accumulation in vegetation, a survey along with Prof Madhulika Singh, Dept of Botany, Sadhu Vaswani College, Bairagarh, Bhopal was conducted in Mandideep industrial area. The identified plant species as bio-indicators are as *Cynodon dactylon, Launia sp, Eichhornia crassipes, Adhatoda vasica, Amaranthus, Rhamnus caroliniana, Lantana camara, Phoenix dactylifera, Euphorbia marginata, Tribulus terrestris, Parthenium, Hygrophila auriculata, Tridax procumbens & Eclipta alba.*

3. Materials & methods:

To evaluate & study the presence and accumulation of heavy metals (Pb, Cd, Ni, Cu, Zn & Cr), samples of water, soil & grass (*Cynodon dactylon)* were collected at identified 13 locations. Three water samples at identified locations of river Betwa were also collected to analyse the concentration of metals. The biomonitoring at 3 locations (U/s, in between Mandideep industrial area & D/s of River Betwa) were also carried out as per the established CPCB protocol.



The sampling locations are mapped tentatively on Mandideep Industrial Area Map & detailed information along with the longitudes & Latitude is as given below in table no.02:

Table no. 02: Details of selected sampling locations at Mandideep Industrial Area

S.No	Location Codes	Locations	Longitudes & Latitudes	Location on Mandideep Industrial Area Map
1.	LOC- 1A	M/s Sanwaria Agro Oils Ltd., Mandideep	23° 5'58.92"N 77°31'9.44"E	Sector- A (In the centre of the Map)
2.	LOC- 2A	M/s IEC, Mandideep	23° 5'26.83"N 77°31'14.90"E	Mandideep New (In South direction)
3.	LOC- 2B	Mahima Dham Colony, Ward No. 17, Mandideep	23° 5'31.36"N 77°30'43.25"E	
4.	LOC- 2C	Agricultural Farm, Mandideep	23° 5'30.04"N 77°30'39.08"E	
5.	LOC- 3A	M/s Lupin Pharmaceuticals, Mandideep	23° 4'39.03"N 77°31'57.13"E	Mandideep New – II (In East direction)
6.	LOC- 3B	M/s Vardhman Yarns Chauraha, Mandideep	23° 4'29.05"N 77°32'1.90"E	
7.	LOC- 3C	Near Maruti Showroom Mandideep	23° 4'4.02"N 77°32'17.26"E	
8.	LOC- 4A	Near M/s Bharat Zinc Ltd, Mandideep	23° 5'26.60"N 77°32'5.18"E	Sector-C (In North direction)
9.	LOC- 4B	M/s Kusum Industries, D-27, Satlapur, Mandideep	23° 5'21.49"N 77°32'46.47"E	
10.	LOC- 4C	Agricultural Farm in Saltapur, Mandideep	23° 5'25.89"N 77°32'51.99"E	
11.	LOC- 5A	M/s Eicher Trators, Mandideep	23° 6'29.64"N 77°30'37.47"E	Sector- D (In West direction)
12.	LOC- 5B	Kalisot Subwells (05 Nos.), Mandideep	23° 6'35.48"N 77°30'29.56"E	
13.	LOC- 5C	Samardha Village, Mandideep	23° 6'58.60"N 77°30'7.60"E	

Sampling & Analysis:

Water:

The water samples for heavy metal analysis were collected in plastic containers of 500 ml capacity from the selected 16 (13 ground water + 03 river Betwa) locations. The groundwater samples were collected from hand pump and bore wells after 2-3 mins of their run to avoid any contamination. Each sample was preserved

immediately in field with concentrated HNO_3 to have the sample pH 2.

Collected sample were analysed for selected heavy metals (Pb, Cd, Ni, Cu, Zn & Cr) on Atomic Absorption Spectroscopy with flame method.

Soil:

To have a homogeneous representative sample of soil of each identified location a rectangular area of 30x50 meters was chosen and with the help of pottery instruments the samples were collected. To avoid the metal contact/contamination plastic & Stainless Steel pottery instruments were used. Soil sampled from the chosen area digged upto 10-20 cm was collected in polybags.

The collected thirteen soil samples were dried at room temperature for 7 days followed by the homogenous sample preparation with the help of pastel & mortar. The grinded samples were sieved through 2mm sieve. To make the sample moisture free, the 10 gms of sieved samples were kept in hot air oven at 60^0C for 3 hours. The dried samples were desiccated and 1gm of desiccated soil sample was weighed for digestion. The 1 gm of each soil sample was mixed in total volume of 100ml (10ml of concentrated nitric acid, 5ml of perchloric acid and 85ml of distilled water). The mixture was digested at 100-150^{o}C for 2-3 hrs on hot plate under fume hood chamber. The final soil extract volume of 5-10ml was filtered and final volume was make up upto 100ml with distilled water.

The 100ml of digested soil sample was analysed for heavy metal concentration through flame method by Atomic Absorption Spectrophotometer (AAS) of *GBC Avanta* ∑ make. The heavy metal concentration was calculated in mg of metal related with kg of dry soil.

Grass:

In view of the easy & everywhere availability of Dooba grass (*Cynodon dactylon*) along with its high metal accumulation & tolerant capacity we chose to sample the same to study the heavy metal accumulation in vegetation near the Mandideep Industrial Area. Near to the soil sample locations, grass was sampled down to the depth where the root can be founded. To avoid the metal contamination the plastic, stainless steel pottery instruments were used.

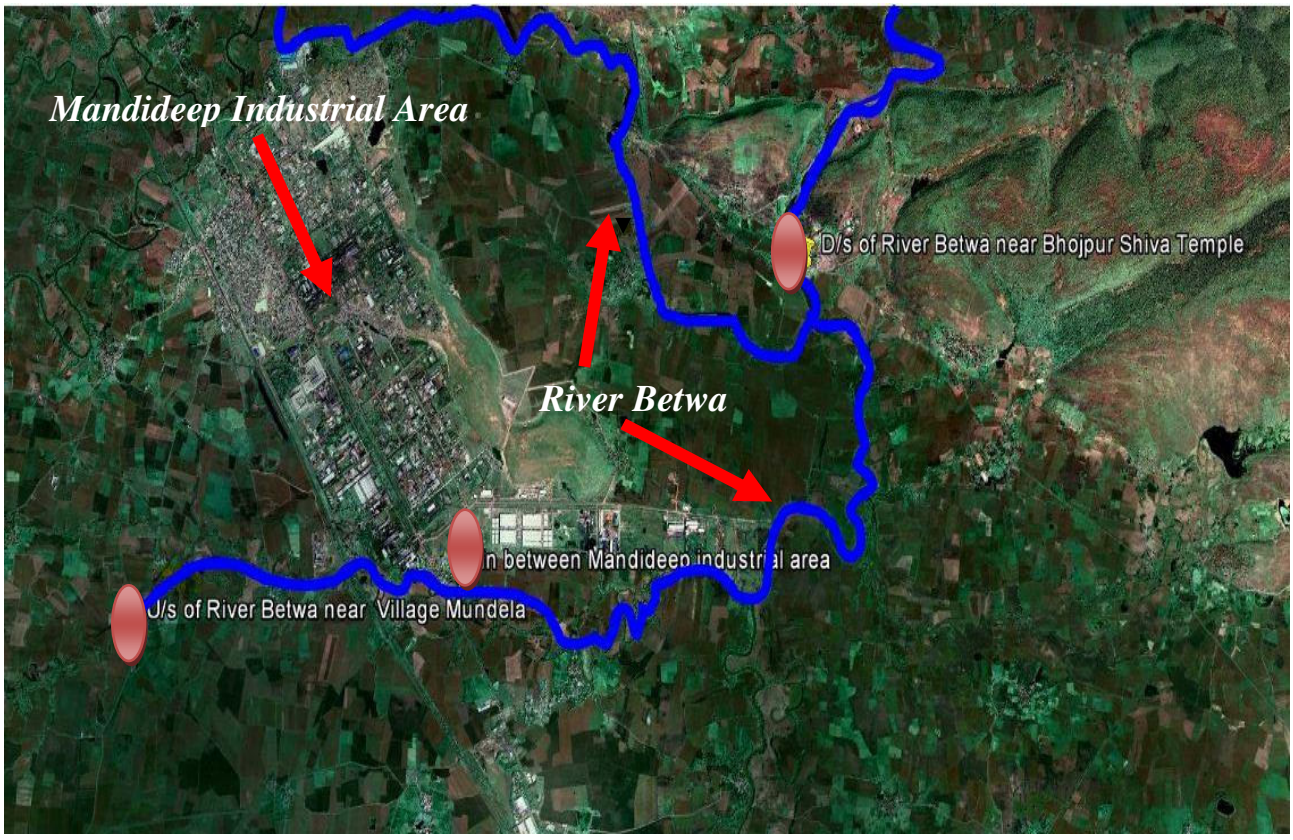
The collected thirteen grass samples were dried at room temperature for 14 days followed by the homogenous sample preparation with the help of pastel & mortar. The grinded samples

were sieved through 2mm sieve. The sieved samples were desiccated and 5 gm of desiccated sample was weighed for digestion. The 5 gm of each grass sample was mixed in total volume of 100ml (10ml of concentrated nitric acid, 5ml of perchloric acid and 85ml of distilled water). The mixture was digested at 100-150^{o}C for 2-3 hrs on hot plate under fume hood chamber. The final grass extract volume of 5-10ml was filtered and final volume was make up upto 100ml with distilled water.

The 100ml of digested grass sample was analysed for heavy metal concentration through flame method by Atomic Absorption Spectrophotometer (AAS) of *GBC Avanta* ∑ make. The heavy metal concentration was calculated in mg of metal related with kg of dry grass.

Biomonitoring:

To obtain the qualitative & quantitative information of fresh water body (river Betwa), sampling & analysis of benthic macro-invertebrates (biological parameter) was carried out at three locations e.g. Upstream (near village Mundela), in between Mandideep Industrial Area & Downstream (near Bhojpur, Shiva temple) as per the CPCB biomonitoring protocol.



Sufficient numbers of macro-invertebrate were sampled in ample amount of sunlight with the help of brush, hand net and shovel samplers. The collected sample were sieved & washed with river water for separating the animals. Organisms were picked up from the sieve with forceps and then placed & preserved with 4% formalin in wide mouth polyethylene bottle of 500ml.

The saprobity (composition of organic matter decaying species) scoring system developed by the British Biological Monitoring Working Party (BMWP) is used to have the qualitative inventerization of the macro-invertebrates benthic fauna upto family level of taxonomic precision. To access the biological consequences of pollution or diversity score, a rapid numerical method (sequential comparison) was applied on the sample species.

4. Results & Discussion:

Water:

The 16 (13+03) water samples collected throughout the Mandideep Industrial Area along with river Betwa e.g. U/s of River Betwa, In between the Mandideep Industrial Area & D/s of river Betwa showed only the presence of Zn (mg/l) other then the Pb, Cd, Ni, Cu & Cr heavy metals shows that the surface (river Betwa) & ground water of Mandideep Industrial Area is not contaminated with the toxic heavy metals. As per the Drinking water quality standard *(IS-10500-1991)* the desirable limits of **Zn** is **5 mg/l** (max).

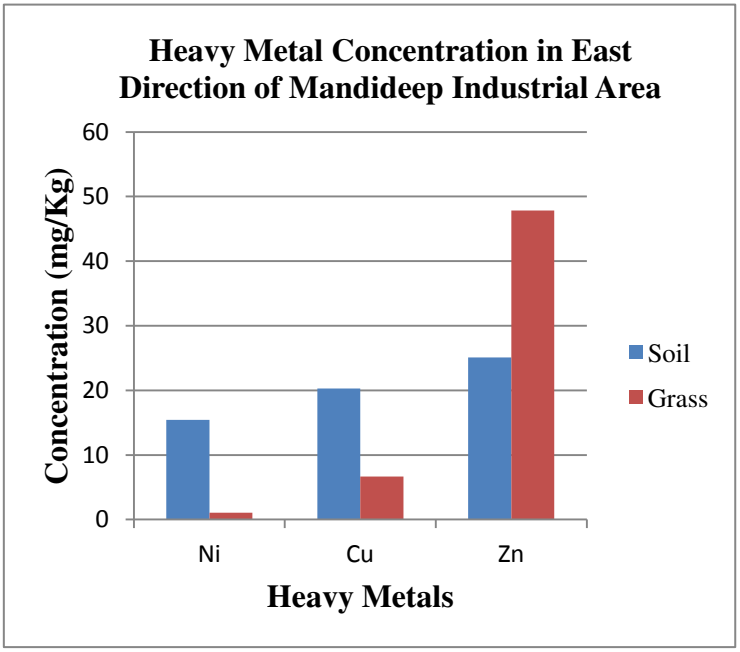
S.No.	Locations	Zn (mg/l)
1.	U/s of River Betwa near village Mundela	**0.035**
2.	River Betwa through Mandideep Industrial Area	**0.048**
3.	D/s of River Betwa near Bhojpur, Shiva temple	**0.045**
4.	M/s Sanwaria Agro Oils Ltd., Mandideep	**0.065**
5.	M/s IEC, Mandideep	**0.057**
6.	Mahima Dham Colony, Ward No. 17, Mandideep	**0.063**
7.	Agricultural Farm Mandideep	**0.030**
8.	M/s Lupin Pharmaceuticals Mandideep	**0.197**
9.	M/s Vardhman Yarns Chauraha Mandideep	**0.101**
10.	Near Maruti Showroom Mandideep	**0.035**
11.	Near M/s Bharat Zinc Ltd, Mandideep	**0.022**
12.	M/s Kusum Industries, D-27, Satlapur, Mandideep	**0.042**
13.	Agricultural Farm in Saltapur, Mandideep	**0.038**
14.	M/s Eicher Trators, Mandideep	**0.557**
15.	Kalisot Subwells (05 Nos.) Mandideep	**0.197**
16.	Samardha Village, Mandideep	**0.022**

Soil & Vegetation (grass):

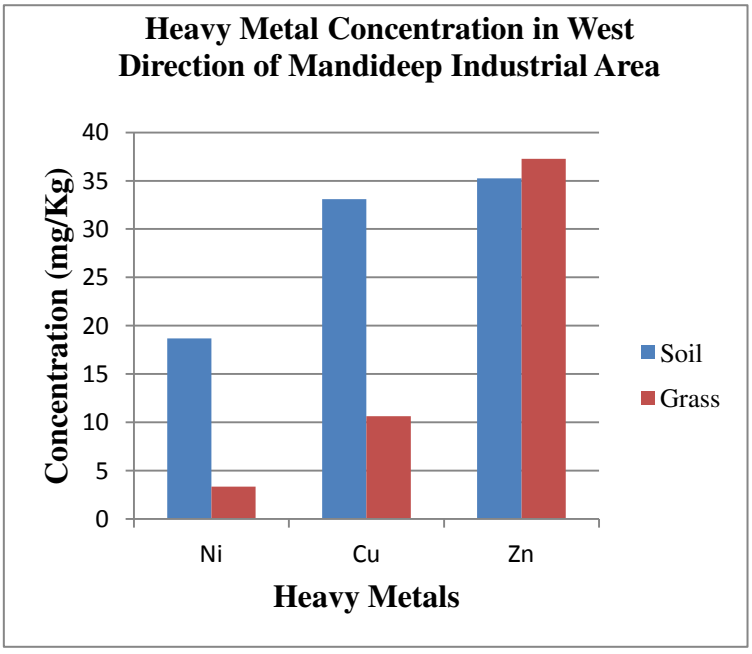
The soil & grass sampling carried out in all four directions of Industrial area with an idea of studying the heavy metal accumulation in plants with reference to the nearby soil. The analysis results states that out of analysed 6 heavy metals (Pb, Cd, Cu, Ni, Cr & Zn) Mandideep Industrial Area has only three heavy metals (Ni, Cu & Zn) in its soil & plant species.

The graphical data presentation done to understand the accumulation of heavy metal in plants with respect to the metal concentration in nearby soil shows that plants (grass) are good heavy metal accumulator as well as a good bio-indicator of pollution. The averaged value of each metal in each direction (three sampling points) was used to co-relate the soil-plant interaction and accumulation of metals.

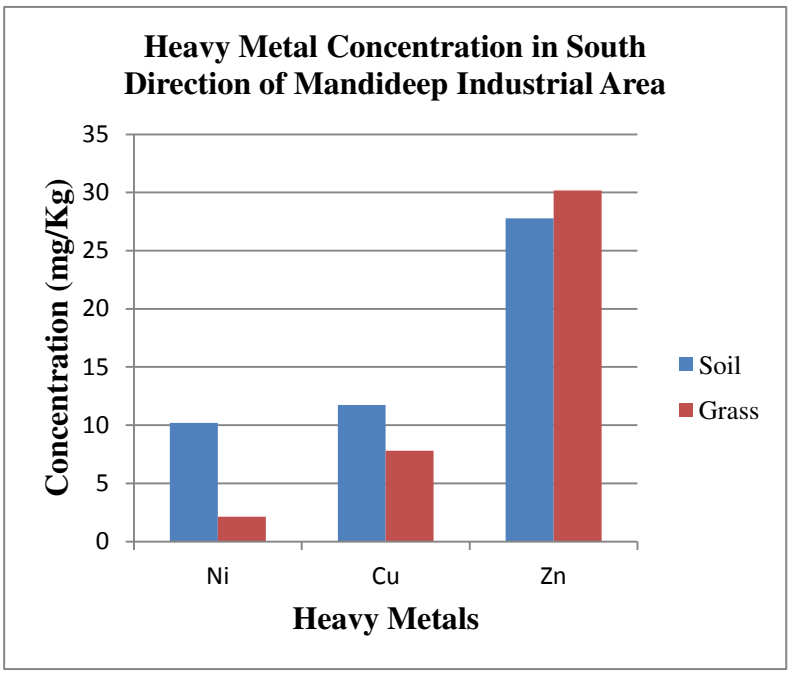
In East direction of Industrial Area, three sampling points were M/s Lupin Pharmaceuticals, M/s Vardhman Yarns Chauraha & near Maruti Showroom, Mandideep shows the accumulation of Ni & Cu in grass lesser than the soil metal concentration. However, the Zn concentration in grass is higher than the soil. The higher accumulation or concentration of Zn in grasses may be due to their requirement by plants as micronutrients.



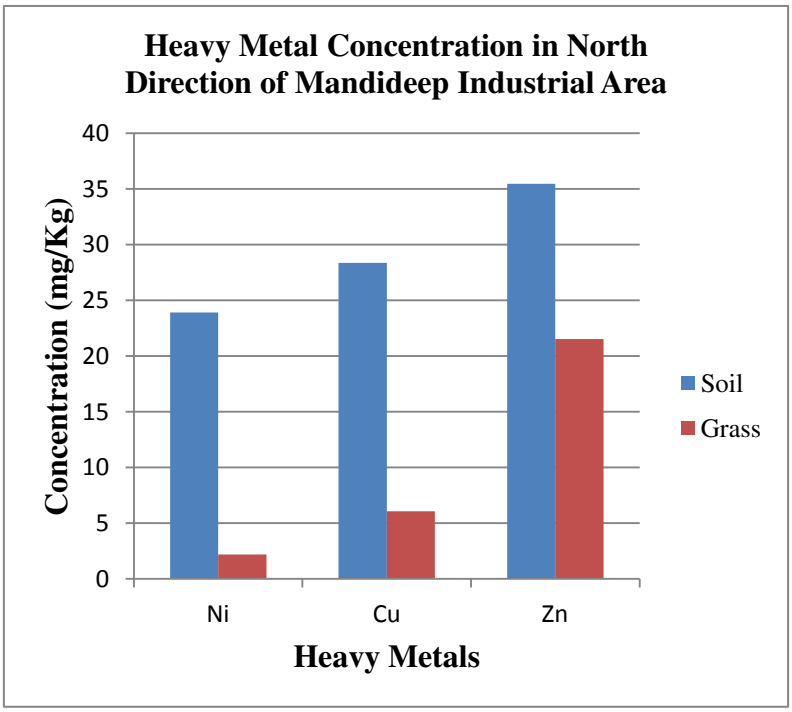
In West direction of Industrial Area, the three sampling locations were M/s Eicher Tractors, Kalisot Subwells (05 Nos.) & Samardha Village, Mandideep. The same pattern of accumulation & presence of Ni, Cu & Zn was observed in grass. The Ni & Cu metals were lesser in concentration than soil whereas the Zn concentration was higher in grass.



The three sampling points (M/s IEC, Mahima Dham Colony, Ward No. 17 & Agricultural Farm, Mandideep) of south direction has also shown the same accumulation pattern of metals in plants e.g. higher affinity for Zn rather than Ni & Cu.



The North directional sampling points of Mandideep Industrial Area were Near M/s Bharat Zinc Ltd, M/s Kusum Industries, D-27, Satlapur & agricultural Farm in Saltapur, Mandideep showed higher concentration of Zn in soil than plant, this may be due to applied fertilizer in wheat field. However, the Ni & Cu showed the similar pattern of accumulation.



Biomonitoring at River Betwa:

The sampling of benthic macro-invertebrates carried out at 3 locations (Upstream (near village Mundela), In between Mandideep Industrial Area & Downstream (near Bhojpur, Shiva temple)) on **16 February, 2012** were scored as per British Biological Monitoring Working Party (BMWP) scoring method along with the sequential comparison for diversity score. Results for both locations are as below:

Location 01. Upstream of River Betwa near Mundela village:

The depth of muddy river bed was averaged upto 0.7 meters with stagnancy of river water. Farming & cattle bathing was observed as a common practice. Biomonitoring data indicates 06 macro-invertebrate families *(Lepidostomatidae, Atydae, Corixidae, Hydrophilidae, Lymnaeidae & Physidae)* belonging to the 05 number of taxa *(Trichoptera, Crustacea, Hemiptera, Coleopteran & Mollusca).*

The saprobic score at this location along with the diversity score is ***4.57 & 0.54*** respectively. The Biological Water Quality Criteria (BWQC) system developed by Central Pollution Control Board to evaluate the water quality is based on the range of saprobic values & diversity score of the benthic macro-invertebrate families. As per this BWQC system, the upstream water of River Betwa at village Mundela is of **'C' class** having **green color** of water with **moderate water pollution**.

The 'C' class of water quality along with moderate water pollution at upstream of River Betwa may be due to stagnancy, poor oxygen availability & cattle bathing.

Location 02. In between Mandideep Industrial Area:

The discharged effluent confluence/mixed in river Betwa during its flow through the Mandideep Industrial Area, reduced the concentration of dissolve oxygen (DO) upto the level of zero. The non-availability of oxygen results in very poor survival of macro-invertebrates. The biomonitoring was not been carried out as it was observed that the DO of river Betwa was upto the level of zero during Mandideep Industrial Area.

Location 03. Downstream of River Betwa near Bhojpur Shiva temple:

The biomonitoring location at downstream of River Betwa at Bhojpur was having 80% of boulders (>256mm) as substratum and rest was sand, silt & clay. The depth was averaged upto 0.975 meters having floating water. Biomonitoring data indicates 08 macro-invertebrate families *(Lepidostomatidae, Brachycentridae, Gomphidae, Uniionidae, Corixidae, Hydrophilidae, Noteridae & segmented worms family)* belonging to the 06 number of taxa *(Trichoptera, Odonata, Mollusca, Hemiptera, Coleoptera & Oligochaeta).*

The saprobic score at this location along with the diversity score is **6.25** ***& 0.76*** respectively. As per the Biological Water Quality Criteria (BWQC) system, the downstream water of River Betwa is of **'B' class** having **light blue color** of water with **slight water pollution**.

The 'B' class of water quality along with slight water pollution at upstream of River Betwa may be due to rituals practices at the bank of river along with the bathing & washing of cloths.

5. Conclusion:

The discharged effluent waste, generated through Mandideep industrial cluster finally meets River Betwa. The heavy metal analysis report states that river Betwa is free from toxic heavy metal (Pb, Cd, Ni, Cu & Cr) contamination however the Zn concentration was observed, that is also below the lethal concentration as per the drinking water quality standard *(IS-10500-1991)* the desirable limits of Zn is 5 mg/l (max). The observed slight Zn concentration in river water may be due to earlier zinc based industrial operation e.g. M/s Bharat Zinc Ltd.

The slight & moderate water pollution at *D/s* & *U/s* of river Betwa respectively may be due to stagnancy or lean flow of river water along with the religious activities at the river bank. In between the Mandideep Industrial Area the biomonitoring was not carried out due to stagnant water body with zero dissolved oxygen.

The availability of minerals as micro & macronutrients is very much necessary for the plant metabolism & healthy growth. The mineral ion concentration in tissue that reduces the dry weight of tissue by about 10% is considered toxic to the plant. The presence of these toxic mineral metals (Pb, Cd, Ni, Cu, Zn & Cr) studied under this project states that Mandideep industrial area has no visible as well as analytical presence of Pb, Cd & Cr in its soil & plant species (*Cynodon dactylon*). However, the presence of heavy metal Ni, Cu & Zn was analysed and found beyond their required concentration (less than 10mmol per kg of dry matter) in plants. The uptake of Ni, Cu & Zn is carried out mainly by root systems via passive & active transport & seems that's all three soluble metals absorb through the same transport system. The uptake of Cu^{+2}, Ni^{+2} & Zn^{+2} is competitive in nature **(Cuiyun Chen et al., 2009)** Results states that the Zn concentration is higher than Cu & Ni in grass of every sampling direction suggest the competitive transport system. The higher concentration of Zn in grass may also be due to availability in soil.

However, Zn^{+2} needed by plant in auxin synthesis along with the activation of carboxylase, for overall plant metabolism Ni^{+2} & Cu^{+2} are also essential whereas excess concentration of these metals can inhibit the mitotic activities; adversely affect the fruit yield due to chlorosis, necrosis & disruption in photosynthesis.

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