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EFFECT OF INDUSTRIAL EFFLUENT ON *Triticum aestivum*, L.

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ABSTRACT

The present work is based on the effect of industrial effluent (Hingna, M.I.D.C., area) on seed germination, seedling growth, mitotic index, and chromosomal aberrations in the plant, Triticum aestivum Linn. The present investigations were undertaken for the analysis of industrial effluent and its effect on germination percentage, cyto-morphology and seedling height. The pH, DO, BOD and COD were found to be in allowable range, however, the effluent is rich with minerals and nutrients. The heavy metal analysis showed that copper, lead, and chromium are found up to well acceptable level, whereas, arsenic, cadmium, mercury, nickel, and zinc are found to be more beyond the acceptable range in industrial effluent.

Key words: chromosomal aberrations, mutations, industrial effluent, heavy metals, and toxic.

INTRODUCTION

Industries are known to produce various environmental problems in and around factory areas and hence it is necessary to understand the impact of industrial effluent on the environment. Plants have been used as monitors for assessing the influence of pollutants on the environment. The effluent discharge from industries is capable of inhibiting the seed germination and seedling growth (Shukla and Pandey, 1991).

The problem of heavy metal pollution via discharging the industrial effluent into the water resources produced great harm to the aquatic life system. Bioaccumulation of heavy metals in plants can be highly dangerous (Sanitadi Toppi and Gabbrielle, 1999). Since plant is a member of a food chain and may create a risk for man and animals, through the contamination of their food supplies (Fargasova, 1994). Metals and metallic compounds of effluent are known to induce chromosomal aberrations and mitotic anomalies in higher organisms (Sharma and Tulukdar, 1987; Barman and Lal, 1994).

The present investigation includes the analysis of industrial effluent for Physico-chemical parameters, heavy metals, minerals and nutrients analysis. The effect of industrial effluent on germination percentage, cyto-morphology and seedling height of *Triticum aestivum* L. The physicochemical parameters conducted for pH, Conductivity, Dissolved Oxygen, Chemical Oxygen Demand and Biochemical Oxygen Demand.

MATERIALS AND METHODS

The procedure was adopted for physicochemical analysis as per NEERI manual (1986).Heavy metal analysis of industrial effluent was carried out in R.S.I.C. (Regional sophisticated Instrumentation Center), R.T.M. Nagpur University, Nagpur.

For germination percentage and cytological studies the physiologically similar and morphologically uniform seeds of *Triticum aestivum, Linn* were selected for the treatment. Petri dishes and filter papers were disinfected by absolute alcohol. The seeds were also rinsed by 0.5% of $HgCl_2$ to avoid infection. One hundred seeds were used for treatment with three replicas and individual controls were also maintained. Seeds were presoaked in effluent as well as tap water for 6 hours in muslin cloth. These presoaked seeds were arranged on the filter paper. The germination count was carried after three days when the length of root tips was about 1 to 1.5 cm.

Root tips were fixed in modified Cornoy's fluid fixative. After 24 hours, root tips were transferred in 70% alcohol.These root tips were stained with hematoxylin by using iron alum as mordant for cytological studies. On the basis of the cytological observations mitotic index was calculated.

The seeds were arranged in the thick blotting paper folds and arranged in slots. These slots were kept in the trays. The individual trays were filled with industrial effluent and tap water respectively in such a way that seeds should not be immersed in the water. Seedling height was measured in centimeters on graph paper after four days.

RESULTS AND DISCUSSION

In the present study various physicochemical aspects, heavy metal analysis, minerals and nutrients estimation was carried out and data is presented in the tables 1, 2 and 3.

Physicochemical parameters:

pH of the effluent was on the alkaline side having 8.10 whereas in tap water it was 7.23. Alkaline nature may affect the globular protein of plants resulting in retardance of growth. Higher value of pH reduces the germicidal potential of chlorine and induces the formation of tri-halomethane, which is toxic (Trivedi, *et al*, 1987).Conductivity is an important criterion in determining the

suitability of water and waste water for irrigation. Conductivity also influences the growth of microorganisms in the water sample (Deka *et al*, 1997).

Table 1: Physico-chemical analysis of the tap water and industrial effluent.

Sample	Physico-chemical parameters				
	pH	Conductivity (µs/cm.)	D.O. (mg/l)	B.O.D (mg/l)	C.O.D. (mg/l)
Tap water (Control)	7.23	1.04	5.6	0.35	36.00
Effluent	8.10	0.402	4.4	0.10	75.12

Table 2: Heavy metal analysis of industrial effluent

Heavy metals	**Values**
Copper	0.05(mg/l)
Lead	0.10(mg/l)
Arsenic	4.66(µg/l)
Cadmium	0.022(mg/l)
Chromium	0.05(mg/l)
Mercury	40.00 (ppm)
Nickel	0.01(mg/l)
Zinc	0.99(mg/l)

Table 3: Analysis of industrial effluent for minerals and nutrients.

Minerals & Nutrients	**Values (mg/l)**
Carbonate	40.00
Bicarbonate	60.00
Chloride	31.98
Sulphate	20.00
Calcium	58.00
Magnesium	36.00
Sodium	16.00
Potassium	08.00
Phosphate	01.60
Nitrogen	30.00
Manganese	00.39

In the present investigation, the seedling growth was retarded due to less conductivity. Conductivity also influences the growth of microorganisms in the water sample (Deka *et al*, 1997).

The seedling growth was retarded as compared to the tap water. Low oxygen demand affects the synthesis of proteins, metabolic processes and thus affects the growth and reproduction in living organisms. It also results into the chromosomal aberrations up to some extent because genetic material strongly binds with the intrinsic proteins (Trivedi, *et al*, 1987).

The Biochemical Oxygen Demand (BOD) values were 0.10 mg/l in industrial effluent and 0.35 mg/l in tap water. It is the measure of the degradable organic matter present in the water sample.

The Chemical Oxygen Demand (COD) values were 75.12 mg/l. in industrial effluent and 36.00mg/l in tap water. It determines the

presence of toxic waste in the industrial effluent which inhibits the growth of microorganisms.

The data of heavy metals (Table - 2) reveal that the values of all the heavy metals are found to be objectionable for irrigation purpose. Analysis of industrial effluent indicates that it is saturated with the minerals and nutrients (Table - 3).

In the light of above findings, the effect of industrial effluent on germination, seedling growth, chromosomal aberrations and mitotic index were studied.

Germination Percentage and Seedling Growth:

The germination percentage and seedling growth is highly retarded in the industrial effluent as compared to the tap water. This is due to heavy metal toxicity and hindrance of minerals and nutrients imbibition. Seedling growth is more sensitive to heavy metals in comparison to seed germination but Wong and Wong (1989) reported the stimulatory effect of fly ash on seedling growth of *Brassica* depending on the concentration of fly ash amended soil. Begonia, *et al* (1998) reported that root growth in Indian mustard is inhibited by lead nitrate in a concentration and duration dependent manner. The cadmium and lead adversely influenced the seed germination and seedling growth in *Sinapis arvensis, Linn.* (Mustafa and Semin, 2011). Similar findings reported in *Oryza sativa* and *Triticum vulgare* during effluent treatment of Battary and Pharmaceutical Industry (Raju *et al*; 2015). Lead is a toxic environmental contaminant that induces many biochemical and structural changes in biological systems (Minaii *et al,* 2008). The seedling growth decreased with phytotoxic metal ions treatment in *Thespesia populnea* (Kabir *et al*, 2010).

Table 4: Effect of industrial effluent on germination percentage and seedling height.

Treatment	Germination (%)	Seedling Height(cm)
Control(Tap water)	100±0.00	8.1±0.33
(Industrial Effluent)	93±1.33	6.2±0.33

Chromosomal aberrations and mitotic index:

The mitotic index was about 27.30% and 23.00% in control and effluent, respectively (Table- 5). Industrial effluent slows down the rate of mitotic index (Yasar and Ahmet, 2006), observed that in *Lens culinaris,* cadmium reduces the mitotic index and induces chromosomal abnormalities. Zhang, and Yang (1994), also reported that cadmium responsible for the reduction of mitotic index in root cells of *Hordeum vulgare*.

Table 5: Effect of industrial effluent on chromosomal aberration and mitotic index.

	Laggard	Chromosomal Bridge	Fragments	Sticky chromosome	Precocious movements	Total aberrations	Mitotic Index
Control (Tap water)	--	--	--	--	0.01	0.01	27.30
Industrial Effluent	0.34	1.13	0.22	0.33	0.09	2.11	19.33

CONCLUSION

The above results of germination percentage, chromosomal aberrations and seedling growth suggest that the industrial effluent is harmful to the plants as well as to the soil where the heavy metals and other toxic elements are accumulated abundantly. Chromosomal aberrations indicate the level of harm to the genetic material which might be transmitted to the next generation thus induce mutations. From the above findings it was concluded that the industrial effluent required pretreatment before utilization for the irrigational purposes.

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