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IMPACT OF THE FERTILIZER INDUSTRY EFFLUENT ON PLANT CHLOROPHYLL, PROTEINS AND TOTAL SUGARS

Hemen Sarma and C. M. Sarma
Plant Physiology and Biochemistry Lab, Department of Botany, Gauhati University, Guwahati, Assam, India

ABSTRACT

The plant species examined included *Camellia sinensis, Aegle marmelos, Anthocephalus cadamba, Colocasia leaves* (Black) and *Lantana camara* which were growing in the area where the effluents were released. Most of the physico-chemical properties of the effluents such as colour, total solids, COD, BOD and alkalinity were above the permissible limits. The extent of damage caused by the effluents discharged by the fertilizer industries on biochemical properties of plants was investigated. The examined plants showed drastic reduction in essential biochemical parameters such as chlorophyll, protein and total soluble sugars. The results show that almost all the plants were sensitive to toxicity of the released effluent.

INTRODUCTION

Plant live in a state of dynamic equilibrium with the environment. Both, chemical and physical factors, must remain within tolerable limits of plants for their healthy growth. Nutrients in soil must be available in quantity that is neither more nor less at the right time. Any kind of disturbance to this state of equilibrium would result in abnormalities in plants. It is an established fact that industrialization without precaution is always associated with degradation of the environmental quality. The degradation of environmental components has damaging effects on all forms of life including plants. Wastewater discharge from industries contains a variety of materials of both organic and inorganic nature including toxic substances. Liquid industrial wastes are of great concern because of their harmful effect (Manivaskam 1987). Fertilizer factory inherently causes effluent discharge and gaseous emission of various magnitudes that pollute the environment (Nair 1977). Studies on the effect of fertilizer factory effluent on plants were carried by Adhikary et al. (1992), Agarwal & Hemlata (1992), Singh (1994), Subramani et al. (1998) and Sundaramoorthy et al. (2000). However, till date no serious attempt has been taken to identify the impacts of effluents released from the nitrogenous fertilizer industries on native vegetation. Therefore, the present study was carried out to analyse the impact of fertilizer factory effluents on some biochemical parameters *viz*., chlorophyll, proteins and sugar content of some plant species.

MATERIALS AND METHODS

The fertilizer factory effluent samples were collected from middle of the drain at mid depth. Analysis of physico-chemical properties of the samples was done following the methods as described in APHA (1992). Different plant species, *Camellia sinensis*, *Aegle marmelos, Anthocephalus cadamba, Colocasia leaves* and *Lantana camara*, growing in the area where effluents were dumped, were collected. The chlorophyll *a*, chlorophyll *b* and total chlorophyll of fresh leaves of each plant was estimated by Arnon (1949) method. The total soluble sugar was determined by using anthrone method (Thimmaiah 2004). 0.5g sample was extracted with tris (hydroxymethyl) aminomethane-HCl buffer and centrifuged, and used for protein estimation by Lowry's methods (Lowry et al. 1951).

RESULTS AND DISCUSSION

The results of the present investigation clearly revealed that the fertilizer factory effluents affected the biochemical properties of plants growing in the affected area (Table 1). The effluent releases potentially toxic inorganic and organic materials in the soil (Table 2). The effluents were alkaline in nature having odour of ammonia. The values of total nitrogen, sodium, chloride, bicarbonate, sulphate, calcium and magnesium were high with trace amount of hexavalent chromium. A higher amount of suspended and dissolved solids increased BOD and COD values of effluent samples. The present study reveals that deliberate discharge of raw effluent in the river and on arable land may have detrimental effect on plant metabolism. Magnesium is a constituent of chlorophyll and therefore, essential for the formation of chloroplast. It also acts as a phosphorus carrier in plants. However, excess nitrogen and chloride present in the effluent inhibit uptake of other elements like magnesium, potassium and phosphorus (Wilson 1998, Thabaraj et al. 1964). Optimum level of magnesium is also essential to maintain the structure of ribosome and ribonucleoprotein bodies which are essential for protein synthesis. The present study supports that the deficiency of magnesium, potassium and phosphorus reduced the photosynthetic rate which in turn decreased sugar content and protein synthesis within the plant system.

Certain trace elements are essential for plant growth and development but when the level ex-

Table 1: Photosynthetic pigments, protein and total soluble sugars of some plant species growing in the effluent fed land near the BVFC, Namrup, Assam.

Sl. No	Plant	Parameter	Unpolluted	Polluted
1	*Camellia sinensis*	Chlorophyll *a*	1.54 ± 0.05	1.12 ± 0.14
		Chlorophyll *b*	0.63 ± 0.12	0.61 ± 0.13
		Chlorophyll Total	2.16 ± 0.17	1.73 ± 0.35
		Protein	17.8 ± 0.92	12.6 ± 0.93
		Total Soluble Sugar	3.8 ± 1.10	3.1 ± 0.70
2	*Aegle marmelos*	Chlorophyll *a*	1.55 ± 0.06	0.85 ± 0.02
		Chlorophyll *b*	1.27 ± 0.09	1.35 ± 0.04
		Chlorophyll Total	2.82 ± 0.15	2.20 ± 0.06
		Protein	14.2 ± 1.06	9.8 ± 0.55
		Total Soluble Sugar	11.7 ± 1.16	8.9 ± 1.05
3	*Anthocephalus cadamba*	Chlorophyll *a*	2.10 ± 0.05	1.30 ± 0.06
		Chlorophyll *b*	1.38 ± 0.15	0.87 ± 0.05
		Chlorophyll Total	3.48 ± 0.020	2.17 ± 0.01
		Protein	6.5 ± 0.5	3.3 ± 0.7
		Total Soluble Sugar	8.5 ± 1.17	6.5 ± 0.7
4	*Colocasia leaves* (Black)	Chlorophyll *a*	1.14 ± 0.02	0.62 ± 0.06
		Chlorophyll *b*	0.54 ± 0.12	0.22 ± 0.04
		Chlorophyll Total	1.68 ± 0.12	0.84 ± 0.10
		Protein	6.8 ± 0.68	3.1 ± 0.73
		Total Soluble Sugar	8.1 ± 1.10	6.2 ± 1.15
5	*Lantana camara*	Chlorophyll *a*	2.45 ± 0.09	1.10 ± 0.051
		Chlorophyll *b*	1.52 ± 0.056	0.82 ± 0.04
		Chlorophyll Total	3.97 ± 1.07	1.912 ± 0.13
		Protein	4.2 ± 0.50	9.2 ± 0.44
		Total Soluble Sugar	6.4 ± 0.9	5.2 ± 0.90

*Each value is an average of three replicates. Chlorophylls are expressed in (mg/g), while protein and sugar in percentage.

Table 2: Physico-chemical properties of fertilizer factory effluent.

SL No	Parameter	Fertilizer factory effluent
General parameters		
1	pH	10.10
2	Colour	Dark brown
3	Temperature (°C)	31
4	Dissolved oxygen	3.2
5	Biochemical oxygen demand (For 5 days at 20°C)	28
6	Chemical oxygen demand	135.30
7	Oil and grease	2.6
8	Total solids	1215.33
9.	Dissolved solids	1048.00
10.	Suspended solids	167.33
Chemical parameters		
11	a) TKj Nitrogen as N	183
	b) Amonical Nitrogen	160
	c) Nitrite Nitrogen	9.8
	d) Nitrate Nitrogen	8.03
12	Phosphates	0.625
13	Cyanides	Nil
14	Arsenic	Nil
15	Vanadium	18.44
16	Copper	0.043
17	Chloride	358
18	Fluorides	-
19	Hexavalent chromium	0.4
20.	Sodium	23.97
21	Calcium	47
22	Magnesium	35.47
23	Potassium	8.13
24	Iron	1.8

All units are in mg/L except colour and pH.

ceeds they become toxic to plants leading to many abnormalities and ultimately death of plants. Calcium is needed only in trace amounts for higher plants (Wallace et al. 1960.*)*. Calcium is the chief constituent of calcium pectate, the main constituent of middle lamella of cell wall. It is irreplaceable by any other element such as magnesium and potassium and act as an activator of ATPase, metabolism of fat, formation of membranes, carbohydrate metabolism, binding of nucleic acids with protein and counteraction of metal toxicity (Pandey & Sinha 1993).

The highly alkaline effluent seeps through the soil and elevates pH as a result of which calcium induces chlorosis due to uptake of calcium at absorbent sites of roots (Palmer et al. 1963). Phosphorus is an essential element participating in the skeleton of plasma membrane, nucleic acids, many coenzymes and organic molecules such as ATP and other phosphorylated products. Phosphate is also essential for normal translocation of carbohydrates in plants and for changing the starch to sugar. The reduction in soluble sugar content may be attributed to the minimum uptake of phosphorus by the affected plants (Wilson 1998). The study indicates that the effluent of fertilizer factory drastically decreases chlorophyll, protein and sugar contents of the plants. The discharge of effluents from nitrogenous fertilizer factory alters the biochemical characteristics of the plants which in

turn causes deleterious effects on metabolism. The affected plants became pale in colour (chlorosis) and stunted in growth. Results of the present study reveal that plants could be used as biological indicators of pollution prevalent in industrial areas.

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