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Effect of industrial effluent on the plant growth and activity of enzyme amylase

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ABSTRACT

Industrial effluents are ranked as the highest pollutants among all industrial wastes. The industry effluent is highly toxic to flora and fauna due to the presence of excess amount of dissolved solids, chlorides, sulfides, chromium with a very high BOD, COD and conductivity in the effluent From the Common effluent treatment plant (CETP), treated effluent was analyzed for Physico-chemical characteristics and its effect on seed germination, á-amylase activity, and early seedling growth and 100% of the effluent, suggested á-amylase enzyme-dependent inhibition of seed germination. In contrast, compared to the control, shoot length, leaf length, á-amylase activity (IU/g) and fresh weight biomass (g/plant) of seedling found to decrease as the effluent concentration increased.

Keywords— *Physico-chemical parameters, Seed germination, á-amylase activity, Common Effluent Treatment Plant (CETP)*

1. INTRODUCTION

India is one of the major industrial areas. As most of the industries in this area are on a small scale and cannot afford expensive treatment plants on their own. Therefore, to mitigate the pollution from industries, a common effluent treatment plant (CETP) was established in 1996 having a treating capacity of 2.15 million liters per day (MLD). The treated effluent from CETP is finally discharged in the Ganga River through the drain. This wastewater is used for irrigation purposes in the agricultural field on both sides of the drain before entering in the Ganga River. The efficiency of CETP and found a significant reduction in COD and BOD levels during the course of treatment in CETP. In a previous study, inhibition of seed germination, plant growth and pigments content in Phaseolus mungo Roxb with increasing concentration of CETP-treated effluent have been reported. Although á-amylase has a decisive role during seed germination and seedling growth, information on the correspondence between á-amylase activity and seed germination under effluent stress is lacking. Therefore, the aim of this study was to investigate the effect of diluted and undiluted effluent on seed germination, á-amylase activity, and early seedling growth.

Industrialization during the 19th century changed mankind's lifestyle. New technology raised man's standard and made life more comfortable but with increasing industrial development, safe disposal of industrial wastewater has become a more ecological challenge. As the problem of waste disposal has now attained complex dimensions, it becomes essential either to find suitable ways for the safe disposal of these wastes or to suggest novel use, considering them as by-products. Finding a profitable use for this waste could further benefit the economics of the industry. Industrial effluent contains a high concentration of plant nutrients and can be effectively utilized as liquid biofertilizer for soil restoration and sustainable land production. Among the different industries, food processing industrial effluents released from the Alkyl Amine industries are rich in various kinds of nutrients like phosphate, calcium, and magnesium, etc and have good potential in the utilization of released effluents as a source of nutrients for the crops plants.

2. REVIEW OF LITERATURE

In view of the various facts of the problem, as mentioned in the introduction, the pertinent literature on different aspects of the subject under study is reviewed as under. Effect of various industrial effluents like oil refineries, food processing industries, pulp, and paper industries on the seed germination and various parameters of plant growth and yield have been noted earlier by many scientists.

Bossert and Bartha (1985) reported a decrease in seedling emergence with an increasing dose of oily sludge, which contained an excess of methylene chloride.

Fly ash released from Thermal Power Plants also plays a significant role in plant growth and biomass. A linear decrease in the emergence and growth of soybean seedlings with increasing fly ash concentrations was also observed by Shukla and Mishra (1986) and Srivastva and Sahai (1987) respectively.

Narasimha Rao et al. (1992) studied the quality of effluent water discharged from the paper board industry and its effect on plant growth. They found that effluent water could be safely used for irrigation of rice and cotton.

Srivastava et al. (1995) studied the effect of ordnance factory effluent on seed germination and early growth performance of pea seeds. It was found that the ordnance factory effluent was highly deleterious for the germination and early growth performance of seeds and as the concentration of effluent increases the deleterious effect also increases thereby showing the positive correlation.

Chidaunbalam et al. (1996) tested the suitability of the treated effluent of the chemical industry on germination and growth of Vigna radiata and Vigna mungo. The diluted effluent (10% v/v) was found to be effective in promoting germination, growth, chlorophyll and protein content. The study suggests that this effluent may be used for irrigation after suitable dilution.

3. MATERIALS AND METHODS

The effluent was procured from the pharmaceutical industry of "Alkyl Amines Pvt. Ltd. Kurkumb. District Pune. Certified seeds of bajara (Pennisetum typhoides L.) Var. ICPT-8203 was obtained from the market. Seeds were surface sterilized by keeping in 0.1% $HgCl_2$ solution for 10 min and washed with sterile distilled water three times to remove all traces of $HgCl_2$.

Effluent was diluted to 0.5, 0.1, 1.5, 2.0, and 2.5 % with distilled water. Surface sterilized seeds were uniformly spread in the pertiplates on the autoclaved filter papers. 50 seeds were kept for germination in each Petri plate. 10 ml of diluted effluent solutions were added in respective Petri plates. Distilled water was added to the control experiment. This was incubated in the dark at room temperature (R.T)
Enzyme amylase was extracted from 1 g germinated seeds sample of (Pennisetum typhoides L.) Var. ICPT-8203 with 10 volumes of ice-cold 10 mm calcium chloride solution overnight at 4 ^{0}C. The extract was centrifuged at 5000 rpm for 20 min at 4 ^{0}C. The supernatant served as an enzyme source.

The reaction mixtures were prepared by adding 0.2, 0.4, 0.6, 0.8 and 1.0 ml of enzyme extract in 1 ml of starch solution in each reaction mixture. The volume of the reaction medium was adjusted to 2 ml with distilled water. The reaction mixture was incubated at 27 ^{0}C for 15 min. The reaction was stopped by adding dinitro salicylic acid reagent. The reaction mixture was heated in a boiling water bath for 5 min. 1 ml potassium sodium tartarate (40% W/V) was added in each reaction mixture when it was warm. The reaction mixtures were cooled by keeping in running tap water.

The volume of the reaction mixture was adjusted to 10 ml by adding 6 ml of distilled water. Absorbance was measured at 560 nm on the spectrophotometer by using a reaction mixture without enzyme as a blank Enzyme activity was calculated by preparing a standard graph.

4. RESULTS

Results on the effect of increasing concentrations of effluents on seed germination of Pennsetum typhoides L. Var. ICPT-8203 is presented in figure 1 and table 1.

Fig. 1: Effect of increasing concentrations of industrial effluent on the seed germination of Pennsetum typhoides L. Var. ICPT-8203

Table 1: Effect of industrial effluent on the seed germination of Pennsetum typhoides L. Var. ICPT-8203

Concentration of Effluent	Germination percentage h after			
	24	**48**	**72**	**96**
Control	14	19	37	47
0.5%	04	12	17	29
1.0%	01	07	11	15
1.5%	-	-	-	-
2.0%	-	-	-	-
2.5%	-	-	-	-

Results showed that the germination percentage decreased with increasing concentrations of an effluent.

Table 2: Effect of increasing concentrations of effluent on amylase activity of germinating seeds of Pennsetum typhoides L. Var. ICPT-8203

Effluent Concentrations	The activity of Enzyme (U/mg)
Control	1.6871
0.5%	1.5906
1.0%	1.5017
1.5%	1.3660
2.0%	1.2058
2.5%	1.1180

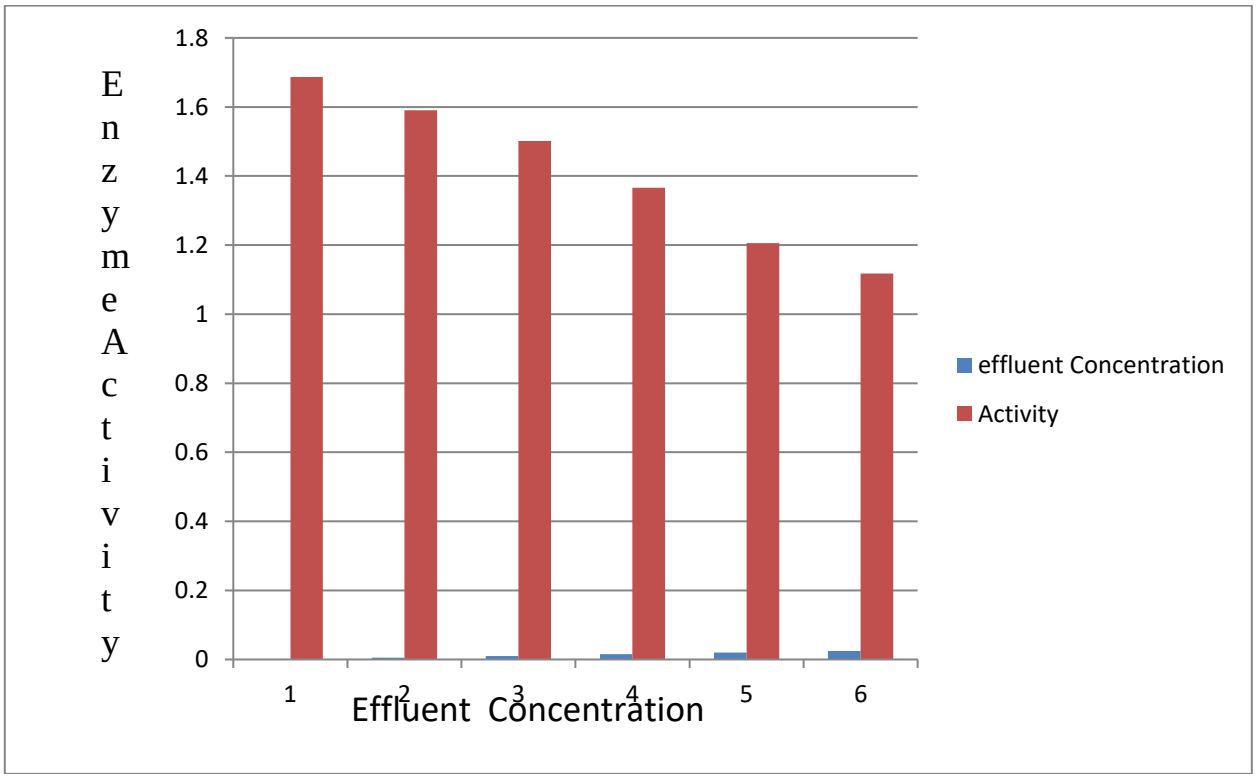

Fig. 2: Effect of increasing concentrations of effluent on amylase activity of germinating seeds of Pennsetum typhoides L. Var. ICPT-8203

5. DISCUSSION

Results on the increasing concentrations of effluent on the seed germination of Pennsetum typhoides L**.** (Table. 1, Fig. 2) showed that the germination percentage was decreased with increasing concentrations of effluent. The activity of enzyme amylase decreased with an increasing concentration of effluent. (Table 2, Figure 2). Abirami. P, Anjanadevi, N and Thangavel, C., Pollution adatement of Dye Industry effluents using aquatic macrophytes, Journal of Industries pollution control, 21(2) (2005) 309- 314.APHA, Standard methods for the examination of water and wastewater, 20th edition, American public health association, American water works association, water environments federation, Washington DC, 2005-2605, 2.36 – 2.39, 2.58, 3.1 – 3.99, 4.105 – 4.178, 5.2 – 5.10. (1998). Bishnoi., S. and Gautam, D.D, Effect of Dairy effluent on seed germination and seedling growth of some crop plants, Int. J. Eco. Environ. Sci 17(1) (1991) 67-71.Ceribasi, H. I and yetis, U. Biosorption of Ni (II) and Pb (II) by phanareochates, Chrysosporium from a binary metal system, Kinetics, Water Research, 27 (1) (2001), 659-671.Choudhary, R.B.Jana, A.K and Jha, M.K. Enzyme technology applications in leather processing, National Institue of Technology, Jalandhar, India, Indian Journal of chemical technology, 11 (2004), 659 -671.Gupta, K.V., Mohan, D., Sharma, S., and Park, T.K., Removal of chromium (VI) from Electroplating Industry Waste water using baggage fly ash – a sugar Industry waste material, The environmental protection, 24 (11) (1991) 863 -866. Jain, .K. and Sharma, M.K. Distribution of trace metal in the lindon river systems, Indian Journal of Hydrology, 253 (2001), 82-90.

6. CONCLUSION

Hence, in the above study, it's suggested that the effluent of the Alkyl Amine industry can be used for irrigation at a lower concentration. This study showed that treated effluent prevented germination of seeds at 75% concentration due to the presence of a variety of toxic substances. This study also demonstrated á-amylase dependent inhibition in seed germination under effluent stress. There could also be some changes in soil characteristics when the effluent used for irrigation. Thus, it is needed that effluents should be properly treated to bring down their adverse effects within tolerable limits.

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