



Effects of sugar factory effluent on maize seedlings

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Abstract: Among the various kinds of water pollution, the problem of Sugar factory effluent has a serious one in India and play major role in polluting the water bodies and land by discharging a large amount of wastewater as effluent. The sugar factory effluents are containing high amount of suspended solids, dissolved solids, BOD, COD, oil & grease. The continuous use of sugar factory effluents can harmfully affects the soil and ultimately crops, if used for irrigation. In the present study, the effect of various concentrations *i.e.* 0 (Control), 10, 20, 40, 60, 80 and 100% of the effluent on seed germination, seedling growth, amylase and total chlorophyll of maize was studied. Germination percentages and seedling growth decrease with increasing concentration of effluent in the maize seeds except lower concentration of effluent (10%).

Key words: Sugar factory effluent, toxicity, germination, seedling growth, BOD, COD, chlorophyll

Introduction

Sugar factory effluent, when discharged into the environment, poses a serious health hazard to the rural and semi-urban populations that uses stream and river water for agriculture and domestic purposes (Baruah *et al.* 1993). The various metallic and nonmetallic elements act as nutrients but at the higher concentration they show toxic effects on seed germination and seedling growth, ultimately adversely affecting plant growth and yield. These effluents not only increase the nutrient level, but also excess tolerance limits and cause toxicity (Mishra *et al.*, 1999). Avasn and Rao (2000) studied the physicochemical characteristics of sugar mill and distillery effluent respectively. The high values of COD revealed the presence of high concentration of biodegradable organic matter in the effluent Kumar and Gopal (2001). Kaushik *et al.* (1996) reported that low concentrations of sugar factory effluent had no effect on seed germination of *Triticum aestivum* L. Nath and Sharma (2002), also reported that the lower concentration of sugar factory effluent increases the seedling growth, chlorophyll and amylase contents in green gram.

Materials and methods

The sugar factory treated effluent was collected in glass bottles from the common discharge channel (distance of sampling point was 100 m from discharge point) and properly sealed. This effluent was analyzed for various physico-chemical properties as per methods described by APHA (1995). Different dilution levels of this effluent mixture were used for the experiment purpose *i.e.* 0 (Control), 10, 20, 40, 60, 80 and 100%. Maize (*Zea mays* L., c.v. – C-101), seeds were used for the experiment. 50 seeds were placed on filter paper in each petridish and treated with 20 ml of each concentration. Whole experiment was conducted in triplicate. The growth parameters like germination % (recorded in first week),

Shoot and root length, fresh weight and dry weight, total chlorophyll contents and total amylase activity were measured in each sample at the end of second week. Fresh weight of 10 seedlings was measured, then they were placed at 80+1°C in a hot air oven for 24 hr and dry weight was measured. The chlorophyll was estimated by using the method of Arnon (1949), total Amylase concentration was estimated by using the method of Katsuni and Fekuhara (1969).

Result and Discussion

The physicochemical properties of Sugar factory effluent shown in Table 1, indicate that effluent was slightly acidic with high in COD, BOD, TDS, TSS, oil and grease. The findings of the experiment are shown in Table 2. Maize showed positive change in case of germination at lower concentration of effluent (10%) in comparison to control while inhibition starts from 20% concentration of effluent. There was slight and gradual reduction in plumule and radicle length from 20 to 100% concentration of effluent in seedlings of maize. The fresh and dry weight significantly inhibited in different treatments of effluent (20 to 100%) as shown in the table 1. The total chlorophyll contents and amylase activity were found to decrease from lower (20%) to higher concentration of effluent. Except this the

Table - 1: Waste water characteristics of sugar factory effluent

parameters	Value
pH	5.9
TDS (mg/l)	2645
TSS (mg/l)	324
BOD (mg/l)	56
COD (mg/l)	506
Nitrogen (mg/l)	68
Oil & Grease (mg/l)	12

Table - 2: Effect of sugar factory effluent on seed germination, seedling growth, chlorophyll and amylase.

Treatments	Germination (%)	Shoot length (cm)	Root length (cm)	Fresh Wt. (g)	Dry Wt. (g)	Chlorophyll (mg/g F.W.)	Amylase (Starch hyd./g FW)
Control	80 ± 2.88	7.56 ± 1.22	5.92 ± 0.95	4.41 ± 0.10	0.458 ± 0.009	1.546 ± 0.065	7.54 ± 0.45
10 %	86 ± 1.66	8.54 ± 0.98	7.22 ± 0.12*	4.97 ± 0.33	0.461 ± 0.004	1.684 ± 0.025	7.98 ± 0.52
20 %	82 ± 2.88	7.50 ± 0.54	7.14 ± 0.51*	4.25 ± 0.52	0.402 ± 0.002*	1.452 ± 0.054	6.89 ± 0.47
40 %	76 ± 1.66	6.89 ± 0.68	6.03 ± 0.81	3.56 ± 0.22	0.354 ± 0.004*	1.112 ± 0.085*	6.54 ± 0.59*
60 %	58 ± 5.00*	5.56 ± 0.65*	5.61 ± 0.84	3.11 ± 0.65*	0.285 ± 0.006*	0.951 ± 0.055*	5.24 ± 0.48*
80 %	50 ± 1.33*	4.65 ± 0.25*	3.52 ± 0.45*	2.95 ± 0.51*	0.254 ± 0.003*	0.587 ± 0.032*	4.95 ± 0.69*
100 %	26 ± 1.33*	3.54 ± 0.54*	2.22 ± 0.47*	2.32 ± 0.21*	0.211 ± 0.007*	0.554 ± 0.035*	2.12 ± 0.22*

Values are mean of three replicate ± SE, * = significant at p < 0.05 level

10 % sugar factory effluent showed promotory effects in case of all parameters.

The results of the effect of sugar factory effluent on seed germination and seedling growth are conclusive that various elements present in effluent act as nutrients but at the higher concentration they show toxic effects on seed germination and seedling growth. The combined effect of wastes of distillery and sugar mill inhibited seed germination, seedling growth and biomass were also studied by scientists in crop plants (Om *et al.*, 1994; Nath *et al.*, 2007, Nath, 2011). The role of amylase with the increased / decreased seed germination were correlated with more / less hydrolysis of starch to release of energy for seed germination (Thevenot *et al.*; 1992; Dunn, 1974; Chang, 1982). These results are also in resemblance to the findings of Rajannan *et al.* (1998), Kumar (1999) and Kumar and Prasad (1999), who showed the carbonaceous sugar mill effluent as a liquid fertilizer and noticed its inhibitory effects on chlorophyll contents, if used in higher concentration. The treated sugar factory effluent as well as untreated sugar factory effluent as such have been shown as toxic (Patil *et al.*, 2001). According to our results sugar factory combined effluent can be used for irrigation at proper interval with dilution.

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