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## **ANALYSE OF THE EFFECT OF SUGAR MILL EFFLUENT IN THE GROWTH BLACK GRAM AND SORGHUM BY GERMINATION STUDIES**

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### **ABSTRACT**

The present study investigated about the efficiency of sugar mill effluent on the germination of monocot (*Sorghum vulgare*) and dicot seeds (*Vigna mungo*) The physico-chemical parameters of sugar mill effluent were analyzed revealed the presence of rich macro & micro nutrients which favored the growth of living organism. Trace amount of heavy metals were also in the soil. On constant irrigation deposition of heavy metal occur which favored the inhibition of plant growth during consecutive cultivating the seeds of monocot & dicot in polluted normal soils. The seeds cultivated in polluted soil showed low response than the seeds cultured in the normal soil. The shoot length, dry weight, chlorophyll estimation were high in the seeds cultured in the normal soil than the polluted soil. Germination studies were also studied with the different concentrations of sugar mill effluent. As the concentration increases, the germination percentage of seed decreases. Thus the present study can be concluded that the effluent cannot be utilized for irrigation. Since the heavy metals get accumulated in the soil on consecutive irrigations.

**Keywords:** Physico-chemical parameter, Sugar mill effluent, polluted and Non polluted soil, germination studies, chlorophyll estimation.

## INTRODUCTION

Soil is an important edaphic factor it play a versatile role in growth of the living organisms. Now days due to industrialization many industries are emerged out and it is created pollutions Sugar industry is back bone of rural, agricultural and socioeconomic development in India. Many industries directly (or) indirectly depend on sugar industry which in turn is responsible for overall development of state in this context sugarcane production is vital importance for its products and by products. Disposal of industrial effluent is the major cause of soil pollution. The content organic and inorganic as well as non biodegradable material touch toxic chemicals affect the soil parameters and soil fertility farmers have been using these irrigation and found that the growth, yield and soil health were reduced. Contaminants such as Chloride, Sulphate, Phosphate, Magnesium and Nitrate are discharged with the effluent of various industries, which create a nuisance due to a physical appearance, odour and taste. Such harmful water is injurious to plant, animals and human beings. Diverse sugar industry effluents disposed in soil and water cause major pollution problem. Sugar factory effluent that has not been treated properly has an unpleasant odour

when released in to the environment farmers using this effluent for irrigation to reduce water demand have found that plant growth and crop yield were reduced and soil health was compromised. Sugar industry effluent is commonly used for irrigation. It is essential to determine how crops respond when exposed to industrial effluent. The effluent not only affects the plant growth but also deteriorate the soil properties when used for irrigation. The polluted soil become unsuitable for further cultivation so there is needs to conduct some kind of source of environment in that way microorganism play a major role in bioremediation of contaminated soil.

### **Deterioration of soil fertility**

Contamination of soil in cultivated fields by industrial effluent loaded with toxic heavy metals has emerged as a new threat to agriculture. Most of the effluent and wastes contain heavy metals in an amount sufficient enough to cause toxicity to crop plants. Excessive accumulation of heavy metals like nickel, copper, cobalt in soil originating from metal mining and processing and other technological activities of man have been reported on a number of occasions. The quality of irrigation water has great importance since

many soil properties may be affected. The important quality parameter of waste water from an agricultural point of view physical properties such as Tds, Ec, Temperature, Turbidity, Hardness and Sediments, chemical properties such as Alkalinity, Acidity. The discharge of sugar mills waste to surface bodies with a high Tds adversely affects aquatic life, damage crop yields if used for irrigation. There are however possibilities of accumulation of sludge in the irrigated soils. The present study was investigated about the physico-chemical parameter of the sugar effluent, germination studies, chlorophyll estimation of Monocot and Dicot seeds

## **MATERIALS AND METHOD**

### **Collection of sugar mill effluent**

The sugar mill effluent was collected from the sugar industry, The Salem co-operative sugar mill at Mohanur, Namakkal District, Tamil Nadu. The fresh samples were collected in a sterile plastic cane for the study. The sample was brought to the laboratory to keep a for the further analysis.

### **Collection of soil sample**

The soil samples of both polluted and non polluted were collected from the cultivable land. The physico-chemical

parameters of both the soil samples were analyzed.

### **Collection of seeds**

Healthy certified seeds of black gram and sorghum were procured from seed seller in Namakkal.

### **Analysis physico-chemical parameter of sugar mill effluent and polluted and non polluted soil**

The collected sugar mill effluent assessed for various physico-chemical parameters like Colour, Odour, Turbidity, pH, Electrical conductivity, Total suspended solids ( TSS), Total Dissolved Solids (TDS), Total solids (TS), Biological Oxygen Demand (BOD), Chemical Oxygen demand(COD), Chloride, Sulphate, cadmium, Magnesium, Sodium, Potassium and heavy metal Zinc were measured using standard methods APHA, (1990). Standard methods for examination of water and wastewater. 20<sup>th</sup> edition American Health Association, Washington, DC.

The collected soil samples assessed for various physico-chemical parameters like pH, Electrical conductivity (EC), Organic carbon, Available Nitrogen, Available Phosphorous, Available Zinc, Available Potassium, Available Copper, Available Iron, Available Magnesium and

heavy metal Chromium, Lead, Cadmium. Jackson, M.L. (1973), Linsay, W.L. and Norwell, W.A. (1978), MAFF. (1986), Piper, C.S. (1994).

### Germination studies

Petri dish Experiments (Thamizhiniyan *et al.*, 2009)

Culture experiment (Ezhilvannan *et al.*, 2011)

### Germination percentage

Germination percentage determined by this formula,

Germination percentage =  $\frac{\text{Number of seeds germinated}}{\text{Total number of seeds shown}} \times 100$

**Seedling length:** The length of root and shoot was measured with wetted (for flexibility) and scale.

**Fresh and dry weight:** The removed seedling were wrapped with aluminium foil and kept in the oven at 80°C for 24 hours. A single pan electrical balance was used for weighing.

**Estimation of pigment content of primary leaves:** The pigments were extracted according to the procedure of Arnons method.

### RESULTS AND DISCUSSION

The effect of sugar mill effluent was studied through germination studies with the seeds of monocot and dicot plants. Prior to this study the physico-chemical parameters were analyzed on both sugar mill effluent and soil samples (polluted & non polluted soil). The effluent was alkaline in nature. Required amount of macro & micro elements were present. The results obtained were tabulated in TABLE-1. The heavy metals were also present. Sallequzzman *et al.*, 2008 stated that the sugar mill effluent has high TDS value, high BOD value, high conductivity value like high Ca, Mg, K,  $SO_4$ ,  $Cl^-$ , etc. contents indicates high pollution of effluent.

**Table: 1 Physico-chemical parameters of the sugar mill effluent**

S.NO	Name of the parameter	Sample
1.	Colour	Deep brown
2.	Odour	Dis. Agre
3.	Turbidity	Highly turbid
4.	Total solids (mg/1)	2159

5.	Total suspended solids (mg/1)	489
6.	Total dissolved solids (mg/1)	1683
7.	PH	8.45
8.	Electrical conductivity (dsm <sup>-1</sup> )	2.63
9.	BOD (mg/1)	2250
10.	COD (mg/1)	3200
	<b>Anions</b>	
11.	Chloride (mg/1)	539
12.	Sulphate (mg/1)	126
13.	Calcium (mg/1)	589
14.	Magnesium (mg/1)	126
15.	Sodium (mg/1)	236
16.	Potassium (mg/1)	0.11
	<b>Heavy metals</b>	
17.	Zinc (mg/1)	0.96

**Table: 2-Physico-chemical parameters of the polluted and non polluted soil**

S.NO	Name of the parameter	Sample	
		NP	P
1.	pH	8.06	8.12
2.	Electrical conductivity(dsm <sup>-1</sup> )	0.18	1.52
3.	Organic carbon (%)	0.26	0.32
4.	Available Nitrogen (Kg/ac)	132.0	189.3
5.	Available Phosphorus (kg/ac)	3.89	6.38
6.	Available Potassium (Kg/ac)	125	206
7.	Available Zinc (ppm)	0.96	1.72
8.	Available Copper (ppm)	1.06	2.36
9.	Available Iron (ppm)	5.69	15.63

10.	Available Magnesium	11.3	12.5
	<b>Heavy metals (ppm)</b>		
11.	Chromium	0.02	0.29
12.	Lead	0.02	0.23
13.	Cadmium	NIL	0.06

### **Detection of physico-chemical parameters of soil samples**

Both the soil samples were slightly alkaline in nature, which is suitable for the growth of the plant. The experimental results indicated that most of the physico-chemical parameters such as silt, clay, electrical conductivity, water holding capacity, organic matter and total nitrogen,

Petri dish experiments were conducted to test the efficacy of seeds in different concentration of effluent. The results obtained were tabulated as (TABLE -3& 4). Both Monocot and Dicot seeds were used to test the germination percentage. Comparatively Dicot seeds (seeds of *Vigna mungo*) showed a higher percentage in germination than monocot seeds (seeds of *Sorghum spp*). In combined with this, shoot length, and dry matter were also studied. Dicot seeds showed good results than monocot seeds.

### **Chlorophyll estimation in Petri dish experiment**

phosphorous and potassium, microbial population high in the test sample than in the control (venkateshwar Reddy *et al.*, 2013) was compared with the obtained results. The obtained results were tabulated inTABLE-2.

### **Germination studies**

Depending on the concentration of effluent the shoot length, dry matter& germination percentage showed variation. The results were inversely proportionate with the effluent concentration. The shoot length, dry matter & germination percentage showed variations. The results obtained were similar to the work done by (Siva Shanthi and Suja Pandian, 2012) which stated that as the germination percentage & germination value decreases with the increase in concentration of effluent.

The pigment analyses, chlorophyll a, chlorophyll b & total chlorophyll were estimated after 15 days of germination, grown in the different concentrations of effluent (Baskaran *et al.*, 2009). Similar to

this work, the work was carried out results were obtained, tabulated in the chlorophyll content were increased as decrease in the concentration of the effluent.

**TABLE - 3 Estimation of germination percentage, shoot length and dry matter, chlorophyll content of dicot plant in Petridish culture at different concentration Black gram (*Vigna mungo* L) Vamban.**

S.No	Treatment	Germination	Shoot length (cm)	Dry matter (g/plant)	Chlorophyll a (mg/g Fw)	Chlorophyll b (mg/g Fw)	Total chlorophyll (mg/g Fw)
1	Control	100	11.8	0.192	1.159	0.462	1.397
2	20%	70	9.8	0.183	1.091	0.458	1.341
3	40%	50	8.3	0.136	1.060	0.450	1.308
4	60%	40	6.5	0.121	0.984	0.452	1.251
5	80%	30	4.3	0.115	0.936	0.467	1.231
6	100%	10	3.3	0.096	0.861	0.466	1.172

**TABLE:4-Estimation of germination percentage, shoot length and dry weight, chlorophyll content of monocot plant in petridish culture at different concentration- Jowar (*Sorghum vulgare* Pers.) Heera**

S.No	Treatment	Germination (%)	Shoot length (cm)	Dry matter (g/plant)	Chlorophyll a (mg/g Fw)	Chlorophyll b (mg/g Fw)	Total chlorophyll (mg/g Fw)
1	Control	90	8.6	0.582	1.601	1.397	2.757
2	20%	70	6.3	0.511	1.518	1.381	2.676
3	40%	60	5.4	0.467	1.364	1.302	2.471
4	60%	50	4.8	0.416	1.271	1.299	2.396
5	80%	30	3.9	0.362	1.099	1.229	2.187
6	100%	20	3.1	0.325	1.043	0.903	1.789

### Pot culture experiment

Pot culture experiment was also conducted. Germination percentage, shoot length and dry matter were high in normal soil than polluted soils (Vijayaragavan *et al.*, 2011) reported that as the

concentrations of effluent increases, there was decrease in the chlorophyll content, similar to this, chlorophyll content was high than the polluted soil. The results obtained were recorded in the (TABLE -5 & 6).

**TABLE: 5-Estimation of germination percentage, shoot length, dry matter, chlorophyll content of dicot plant in pot culture - Black gram (*Vigna mungo* L ) Vamban-2**

S.No	Treatment	Germination (%)	Shoot length (cm)	Dry matter (g/plant)	Chlorophyll a (mg/g Fw)	Chlorophyll b (mg/g Fw)	Total chlorophyll (mg/g Fw)
1	Normal soil	80	13.97	0.212	1.295	0.434	1.471
2	Polluted soil	40	9.84	0.186	0.979	0.379	1.168

**TABLE: 6-Estimation of germination percentage, shoot length, dry matter, chlorophyll content of monocot plant in pot culture - Jowar (*sorghum vulgare* Pers.) Heera.**

S.No	Treatment	Germination (%)	Shoot length (cm)	Dry matter (g/plant)	Chlorophyll a (mg/g Fw)	Chlorophyll b (mg/g Fw)	Total chlorophyll (mg/g Fw)
1	Normal soil	90	16.42	0.602	1.631	1.585	2.985
2	Polluted soil	50	11.58	0.524	1.151	0.894	1.862

## CONCLUSION

The study concluded that physico-chemical parameter such as the pH, EC, Turbidity, TS, TDS, TSS, BOD, COD, Chloride, Sulphate, calcium, Magnesium, Sodium, Potassium and heavy metal Zinc these are high level in sugar mill effluent. When effluent irrigated in the agricultural land was severely affected the soil properties. The germination studies were studied the seed showed the polluted soil

shows the low response compared to the non polluted soil. The shoot length, dry weight, chlorophyll content high response compared to the polluted soil. As the concentration increase the germination percentage decrease. The growth response shows the deposition toxic substance from effluent to soil. So the continuous irrigation should be avoided. So the effluent cannot be utilized for irrigation.

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