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Original Research Paper

The Impact of Distillery Effluent on Germination and Growth Parameters of *Vigna sinensis* L.

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ABSTRACT

An attempt has been made to study the effect of distillery effluent on germination, growth and pigment productivity of *Vigna sinensis* L. The effluent was highly acidic and rich in total dissolved solids, suspended solids, potassium and sulphates. While diluted effluent increased the percentage of germination, growth, amount of chlorophyll and carotenoid, the effluent of higher concentrations elicited deleterious effects on the growth and productivity of the crop.

INTRODUCTION

The ecological state of biosphere is becoming more and more unbalanced due to technological and industrial advancement and population explosion. Environmental pollution creates serious problems for the very existence of life on this planet. An awareness of environmental problems and potential hazards caused by industrial wastewater has prompted many countries to limit the discharge of effluents.

The effluents often contain considerable amount of essential nutrients, which may prove beneficial to plants (Sheela & Soumya 2004). The present study has been undertaken to evaluate the effect of distillery effluent from Mc.Dowell and H.R.B company, Ltd. on seed germination, growth, chlorophyll and carotenoid pigments and productivity of the plant *Vigna sinensis* L. To understand the effect of effluent on soil, analysis of the soil used for growing the experimental plants and the control plant is also included in the study.

MATERIALS AND METHODS

Before starting the experiment, a sample of the effluent was collected in a plastic container from the main outlet of the factory and its physicochemical properties were analysed.

Surface sterilized seeds were soaked for 24 hours in various concentrations (5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80 and 90%) of the effluent. For control, distilled water was used. Seeds were placed on filter paper in sterilized Petri dishes for germination and moistened with 15 mL of different concentrations of the effluent. After 4 days, the data on the percent germination was collected and the length of the radicle was recorded.

For field studies, the seeds were allowed to grow in soil in polyethylene bags, and irrigated daily with different concentrations (5, 10, 15, 20, 25, 30, 70 and 80%) of the effluent. For control, tap

Table 1: Physicochemical analysis of the effluent.

Parameter	Value
Colour	Dark Brown
Odour	Aromatic
pH	4 - 4.5
BOD	5000 mg/L
COD	100000 mg/L
Total Suspended solids	5000 mg/L
Dissolved solids	76000 mg/L
Sulphates	3500 mg/L
Ammonical nitrogen	500 mg/L
Potassium	7813.16 mg/L
Percentage of alcohol	37

water was used for irrigation. Chlorophyll and carotenoid contents were estimated according to the standard method adopted by Arnon (1949). Length of the plant, length of the petiole and the number of leaves were recorded at 10 days interval. After the completion of growth, the plants were uprooted and dried in hot air oven at 100°C for 5 days for recording dry weight. For each treatment, three replicates were maintained and samples of dry soil of each treatment were collected for soil analysis.

RESULTS AND DISCUSSION

The physico-chemical data reveal that the effluent is highly acidic in nature (Table 1). At higher concentration (90%), there was complete inhibition of seed germination. This is due to high levels of total dissolved solids, which enrich the salinity, and conductivity of the solution absorbed by seed before germination. The data of germination percentage show that the rate of germination is similar to that of control up to 10% effluent, but decreased with the increase in effluent concentration (Table 2). These observations are in agreement with those of Ghosh & Kumar (1998) and Sharma et al. (2002). Radicle length increases up to 10% concentration.

The amount of chlorophyll and carotenoid was found to be increasing at lower concentration. Maximum chlorophyll and carotenoid contents were observed in plants treated with 5% and 10% effluent. The concentration of chemicals in this dilution is at the optimum level, which favoured the biosynthesis of chlorophyll and carotenoid (Table 5). Madhappan (1993) also supports these findings.

In the case of growth study, the shoot length increased considerably in 5% and 10% effluent concentration and decreased at higher concentrations (20% to 30%). The 70% and 80% effluent concentrations proved to be lethal (Table 4). The inhibitory effect at higher concentration is due to the excess of total nitrogen, sulphates, dissolved and suspended solids present in the effluent. The

Table 2: Effect of effluent on germination and radicle length of *Vigna sinensis*, L.

Concentration of effluent %	% of Germination	Radicle length (cm)		
		4th Day	5th Day	6th Day
Control	80	6.3±0.1	9.6±0.31	11.1±0.23
5	80	6.4±0.11	10.6±0.15	11.3±0.17
10	80	5.1±0.41	7.6±0.48	9.7±0.384
15	76.6	4.8±0.548	5.3±0.415	7.1±0.48
20	70	4.1±0.142	4.8±.054	6.9±0.53
25	60	3.8±0.6	4.1±0.46	4.8±0.56
30	60	3.5±0.24	3.9±0.38	4.1±0.24
40	56.6	2.9±0.094	3.2±0.38	3.9±0.212
50	40	2.7±0.31	3.1±0.21	3.7±0.31
60	40	1.9±0.54	2.2±0.45	2.7±0.215
70	26.6	1.6±0.25	1.9±0.23	2.2±0.38
80	10	0.5±0.11	0.8±0.21	1.1±0.18
90	0	-	-	-

Table 3: Soil analysis after irrigation with different concentrations of the effluent.

Concentration of effluent %	pH	mmhos/cm	N%	P, kg/ha	P, kg/ha
Control	6.7	1.26	0.28	110	95
5	6.63	1.26	0.30	110	114
10	6.6	1.35	0.33	110	226
15	6.6	2.2	0.40	110	380
20	6.5	2.52	0.42	110	380
25	6.5	3.82	0.44	110	380
30	6.4	4.09	0.45	110	380
40	6.3	4.09	0.45	110	380
50	6.19	4.15	0.48	110	380
60	5.9	4.384	0.55	110	380
70	5.8	4.6	0.65	110	380
80	5.6	4.62	0.70	110	380
90	5.3	4.73	0.73	110	380

Table 4: Effect of effluent on petiole length, total length, no. of leaves and dry weight of *Vigna sinensis*.

Concent-ration of effluent %	Total length of petiole after days (cm)					Total length of plant (cm)					No.of Leaves after60 days	Dry weight after 60 days (g)			
	10th	20th	30th	40th	50th	10th	20th	30th	40th	50th		Stem	Root	Leaf	Fruit
Control	4.11± 0.43	4.27± 0.38	4.48± 0.42	4.92± 0.11	5.49± 0.43	15.7± 0.851	21.2± 0.931	50.1± 0.931	83.9± 0.87	109± 0.93	10	1.24	0.57	0.89	0.10
5	4.31± 0.381	4.99± 0.611	5.08± 0.29	5.37± 0.43	5.98± 0.27	16.1± 0.872	21.3± 1.208	50.8± 0.981	86.3± 1.06	118.3± 1.12	11	1.28	0.59	0.91	0.10
10	4.23± 0.31	4.52± 30.521	4.59± 0.31	4.99± 0.29	5.52± 0.13	15.9± 1.257	20.5± 1.197	41.2± 1.329	79.2± 0.94	98.9± 1.21	10	1.21	0.62	0.98	0.10
15	3.19± 0.421	3.65± 0.43	3.71± 0.20	3.98± 0.33	4.32± 0.25	15.8± 1.318	21.1± 1.235	39.6± 1.149	68.7± 1.30	88.6± 1.24	9	1.04	0.45	0.88	0.08
20	3.08± 0.409	3.56± 0.271	3.6± 0.29	3.82± 0.40	4.21± 0.16	13.5± 1.237	17.8± 1.089	21.6± 1.179	42.1± 1.29	63.4± 1.18	9	1.01	0.29	0.63	0.08
25	3.02± 0.276	3.55± 0.31	3.59± 0.32	3.79± 0.37	4.03± 0.41	12.2± 1.13	16.3± 1.219	20.2± 1.198	39.7± 1.09	61.1± 1.17	8	0.78	0.32	0.59	0.08
30	2.93± 0.287	3.17± 0.277	3.23± 0.19	3.46± 0.23	3.91± 0.35	8.9± 1.271	11.8± 1.186	18.4± 1.179	37.2± 1.20	58.4± 1.18	7	0.69	0.29	0.57	0.08
70	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5: Effect of different concentrations of effluent on the productivity of chlrophyll and carotenoid pigments.

Concentration of effluent %	Chl. *a* mg/g tissue	Chl. *b* mg/g tissue	Total Chl. mg/g tissue	Carotenoid mg/g tissue
Control	0.886	0.548	1.434	0.512
5	1.389	0.978	2.367	0.742
10	1.085	0.799	1.884	0.621
15	0.805	0.529	1.333	0.439
20	0.660	0.495	1.154	0.393
25	0.483	0.295	0.778	0.321
30	0.462	0.208	0.667	0.306

presence of these constituents in excess proved to be injurious to plant growth as they affected water absorption and other metabolic processes in the plant. Soil analysis reveals that the NPK content of the soil also increased significantly by effluent treatment (Table 3). Nutrients such as nitrogen, phosphorus and potassium present in the diluted effluent played a role in promoting plant growth in lower concentration. Several authors have reported similar results where soil was treated with various effluents (Renu Rani et al. 1990, Rajaram & Janardhanan 1988).

The present study reveals that the distillery effluent has deleterious effect on the growth of *Vigna sinensis* L. at higher concentration. The results obtained at 5% and 10% effluent concentrations were invariably better as compared to the control. It appears that these concentrations of effluent act as a liquid fertilizer. Hence, the distillery effluent can be used for irrigational purposes at 5% and 10% level of dilution.

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