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Effect of sugar industry effluent on changes of growth and biochemical contents of *Capsicum annuum*. L

Suresh B., Abraham K. and Damodharam T.*

Department of Environmental Sciences, S. V. University, Tirupati, A.P., India

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ABSTRACT:

The physico-chemical characteristics of Sugar industry effluent were measured by standard methods. The pot culture experiment was conducted with different concentrations (0%, 25%, 50%, 75% & 100%) of Sugar industry effluent .The effect of sugar industry effluent on Capsicum annuum. L. at day's interval 10th, 20 th, and 30th was observed. The present study was initially conducted the effect of different concentrations of Sugar industry effluent on seed germination, plant growth and biochemical parameters of Capsicum annuum .L. The plant growth was significantly reduced with increase in concentration of the effluent. At higher effluent concentrations (above 50%) were found to affect plant growth and decreased Chlorophyll-a, Chlorophyll-b and total Chlorophyll and Protein contents, but diluted effluent (up to 50%) favored the plant growth and biochemical contents.

Keywords: Sugar industry effluents, germination, growth, biochemical etc.

INTRODUCTION

During the past few decades Indian industries have registered a quantum jump, which has contributed to high economic growth but simultaneously it has also given rise to severe environmental pollution. In recent years, much of effluent from various industries like chemical, sago, sugar the water bodies has become polluted by sewage, industry, textile, dairy, tannery industries are the major cause industrial wastes and wide array of synthetic chemicals (Hariharan, K .2002). Sugar industry is one of the most important agro-based industries in India and has significantly contributed to countries economy (Doke KM *et al*., 2011, Siva SK and Suja PR, 2012, Siddiqui WA and Waseem M, 2012). As India is the largest producer of sugarcane in the world with 550 Sugar mills and 220 million tons cane per year and total Sugar production 13.5 million tons per year. Sugar production processing requires huge water for a number of steps and released almost equal quantity of effluent which contains toxic material (Kaur A, *et al*., 2010). The effluent contains various inorganic and organic substances in different concentration may affect the growth and germination of crop plants. The agriculture production is heavily affected by the reckless (Polluted) discharge of Paper and Sugar industry effluents to the water bodies. (Beg, M.U. *et al*., 2001, Hopetti 1995, Dandge, P.R. 2001). The sugar industry plays an important role in the economic development of India, but the effluents released produce a high degree of organic pollution in both aquatic and terrestrial ecosystems (Ayyasamy *et al.*,2008) to economize the irrigation water industrial effluents are now-a-days commonly used for irrigation. Sugar factory effluent has an obnoxious odor and unpleasant color when released into the environment without proper treatment. The pollutants like chloride, sulfate, phosphate, magnesium and nitrate are released with the effluent (Saranraj and Stella, 2012). Higher concentration of sugar mill effluents could inhibit seed germination and seedling growth and eventually yield in some crops such as green gram (Baskran *et al*., 2009), sorghum (Doke *et al*., 2011), peanut (Siva Santhi and Suja Pandian, 2012). The physico-chemical analysis of Sugar industry effluent affected soil revealed the presence of higher amount of minerals, toxic pollutants and soil organic matter (Baskaran

et al., 2009). The effluent not only affects the plant growth but also deteriorate the soil properties when used for irrigation (Maliwal *et al*., 2004).

MATERIALS AND METHODS

Seed materials:-
The certified seeds of *Capsicum annuum* .L were purchased from A. G. Ranga Agriculture College Tirupati, Chittoor district, A.P. Seeds with uniform size, color and weight were chosen for the experimental purpose.

Collection of effluent from the sugar industry:-
The effluent samples were collected in a pre-cleaned, plastic container from the point of disposal from Sugar industry located at Nelavoy, Chittoor District, A.P, India. The collected effluent was stored at 5°C to maintain its original characteristics (APHA 1998).

Experimental soil:-
The soil used in the experiment was red gravel in nature and the pH of the soil was 4.5. Soil was collected in polythin covers near by the sugar industry.

Physico-chemical characterization of the Sugar Industry Effluent
Physico-Chemical parameters like, Color, Temperature and pH were determined immediately at the site of collection. Electrical Conductivity (EC), Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Chloride, Calcium, Magnesium and Sulphates were measured using standard methods (APHA 1998).

Experimental design:-
For bioassays, the effluent was diluted to 0%, 25%, 50%, 75% and 100% with distilled water. Plant seeds were spread in contaminated soil in pots and then irrigated with 100 ml of the different concentrations of effluent serve as distilled water to control. Each treatment consisted of five replicates. Root, Shoot and seedling growth was measured by meter scale.

Growth analysis:-
The plant samples were collected on 10^{th}, 20^{th} and 30^{th} days after sowing. Germinated plants were collected from the pot to analyze for the various growth parameters such as length of shoot, root and seedling.

Biochemical estimations:-
Leaves of control and treated plants were used for the estimation of Chlorophyll-a, Chlorophyll-b, total Chlorophyll content was measured according to Arnon 1949 and total Protein content was estimated by Lowry *et al*., 1951.

RESULTS AND DISCUSSION

The physico- chemical characteristics of effluent were presented in **Table 1**. The analysis of sugar industry effluent showed that it is acidic in nature with light black in color. It contained low amount of pH and high amounts of Total Dissolved Solids, Biological Oxygen Demand, Calcium and Magnesium was above the permissible limit of Indian Standards. At 75% and 100% of effluent concentration decrease in root, shoot length and seedling growth was recorded on 10^{th}, 20^{th} and 30^{th} days in **Table 3, 4 and 5**.

Shoot, Root and Seedling Growth
Root, shoot length and seedling growth of *Capsicum annuum.* L plant differed with different concentrations of Sugar industry effluents in soil Table 3, 4, & 5. For lower concentrations of irrigated effluent (25% & 50%) the root, shoot length and seedling growth of *Capsicum annuum.* L plant was higher than that of control plant, which may be taken as an indication of beneficial range while for higher concentrations of effluents (75% &100%) a decreasing trend was observed, which confirms the toxic effect of this effluent to *Capsicum annuum* .L plant. These results were corroborating with the findings of Saravanamoorthy. M. D and Ranjita Kumari (2005), in peanut and green gram and Srivastava. S *et al*., 2012, in *Solanum melongena.*

Table 1: Physico- Chemical Characteristics of Sugar industry effluent

S.NO	Parameter	Values	Permissible Limits (IS)
1	Color	Light Black	-
2	Temperature °C	29.0	-
3	pH	4.20	6.5-8.5
4	EC	2.13 µmhos/cm	300
5	DO	9.5	>6
6	BOD	928	100
7	TSS	110	200
8	TDS	1392	1000
9	Chloride	65	600
10	Calcium	452	200
11	Magnesium	594	100
12	Sulphate	360	400

All values are expressed in mg/L, except color, temperature, pH and E.C: IS, Indian Standard

Table 3: Root length of *Capsicum annuum.* L at different time intervals exposed to Sugar industry effluent (cm)

	10th day	20th day	30th day
Control	1.2± 0.17	1.86±0.20	2.69.±0.27
25%	0.7±0.19	1.80±0.11	3.20±0.06
50%	1.8.±0.20	2.41±0.14	4.59.±0.14
75%	0.51±0.17	0.87±0.26	1.53±0.23
100%	0.42±0.20	0.66±0.05	0.89±0.08

Values are arithmetic mean ±SEM of five replicates

Table 4: Shoot length of *Capsicum annuum* .L at different time intervals exposed to Sugar industry effluent (cm)

	10th day	20th day	30th day
Control	10.3±0.17	12.4±0.20	13.7±0.27
25%	13.8±0.17	14.1±0.11	14.9±0.06
50%	14.5±0.20	14.9±0.14	15.7±0.14
75%	8.6±0.17	11.4±0.26	12.3±0.23
100%	8.3±0.20	10.5±0.05	11.3±0.08

Values are arithmetic mean ±SEM of five replicates

Table 5: Seedling growth of *Capsicum annuum.*L at different time intervals exposed to Sugar industry effluent (cm)

	10th day	20th day	30th day
Control	11.5±0.17	14.2±0.20	16.3±0.27
25%	14.5±0.17	15.9±0.11	18.1±0.06
50%	16.3±0.20	17.3±0.14	20.2±0.14
75%	9.1±0.17	12.2±0.26	13.8±0.23
100%	8.7±0.20	11.1±0.05	12.1±0.08

Values are arithmetic mean ±SEM of five replicates

Table 6: Change in Chlorophyll - a content of *Capsicum annuum.*L at different time intervals exposed to Sugar industry effluent (mg g-1 fwt)

	10th day	20th day	30th day
Control	1.327±0.026	2.924±0.073	1.022±0.025
25%	1.439±0.039	2.829±0.087	1.632±0.028
50%	1.763±0.023	2.982±0.040	2.563±0.013
75%	0.961±0.033	1.251.±0.036	0.691±0.031
100%	0.862±0.046	1.132±0.040	0.684±0.032

Values are arithmetic mean ±SEM of five replicates

Biochemical estimations

Chlorophyll-a, Chlorophyll-b and total Chlorophyll and protein content of *Capsicum annuum.*L was higher at low (25% & 50%) concentration of Sugar industry effluent in the soil than in the control plant. Further, the values decreased with a gradual increased in effluent (75% & 100%) concentration **table 6, 7, 8 & 9.**Sugar industry effluent effect and duration of exposure on Chlorophyll – a, Chlorophyll - b and total Chlorophyll content represented in **Table 6, 7 & 8**. Concentration of effluent at 50% increased in Chlorophyll a, b and total Chlorophyll contents up to 20th day and decreased from 25th day onwards in *Capsicum annuum.* L. by the findings of Malla and

Mohanty, 2005; Singh *et al*., 2006. It has been recorded at 75% and 100% effluent concentrations decreased the Chlorophyll and Protein content of *Capsicum annuum* .L at all intervals compare to control due to the findings of L. Baskaran *et al*., 2009.

Table 7: Change in Chlorophyll -b content of *Capsicum annuum*.L at different time intervals exposed to Sugar industry effluent (mg g-1 fwt)

	10th day	20th day	30th day
Control	0.615±0.054	0.956±0.015	0.561±0.044
25%	0.902±0.018	1.727±0.042	0.815±0.001
50%	1.352±0.039	1.626±0.001	0.857±0.140
75%	0.521±0.009	0.860±0.022	0.319±0.034
100%	0.491±0.005	0.624±0.020	0.201±0.012

Values are arithmetic mean ± SEM of three replicates

Table 8: Change in total Chlorophyll content of *Capsicum annuum*.L at different time intervals exposed to Sugar industry effluent (mg g-1 fwt)

	10th day	20th day	30th day
Control	2.152±0.079	4.257±0.082	1.624±0.023
25%	2.566±0.063	4.486±0.049	2.399±0.017
50%	3.146±0.064	3.816±0.056	2.146±0.030
75%	2.041±0.046	2.124±0.057	0.915±0.064
100%	1.214±0.048	1.581±0.050	0.112±0.052

Values are arithmetic mean ± SEM of three replicates

Table 9: Total Protein content of *Capsicum annuum* .L at different time intervals exposed to Sugar industry effluent (mg g-1 fwt)

	10th day	20th day	30th day
Control	14.3±0.286	17.6±0.023	14.7±0.158
25%	16.5±0.055	18.3±0.158	17.4±0.255
50%	17.7±0.316	19.8±0.121	18.9±0.195
75%	12.8±0.199	15.6±0.199	11.7±0.238
100%	11.4±0.199	13.7±0.199	9.5±0.199

Values are arithmetic mean ± SEM of five replicates

Pot culture experiment of *Capsicum annuum* . L

CONCLUSION

From this study, it was concluded that Physico-Chemical parameters such as Total Dissolved Solids, Biological Oxygen Demand, Calcium and magnesium were relatively high in the Sugar industry effluent and affected plant growth. Chlorophyll - a, Chlorophyll - b and total Chlorophyll and Protein content of *Capsicum annuum.* L was severely affected. The untreated Sugar industry effluent could possibly lead to soil deterioration and low

productivity. The effects vary from crop to crop because each plant species has its own tolerance of the different effluent concentrations. Proper care should be taken in disposal of Sugar industry effluent to avoid soil pollution.

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