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ORIGINAL ARTICLE

PHYSICO–CHEMICAL ANALYSIS OF SUGARMILL EFFLUENTS AND ITS EFFECT ON SEED GERMINATION OF GREENGRAM (*Vigna radiata* L.)

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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 (Control, 10, 25, 50, 75 and 100%) of Sugar industry effluent. The effect of sugar industry effluent on at 7th day germination percentage, root length and shoot length was observed. The present study was initially conducted the effect of different concentrations of sugar industry effluent on seed germination, plant growth of greengram (*Vigna radiata* 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 but diluted effluent (up to 50%) favoured the germination and plant growth.

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

1.INTRODUCTION

Industrialization leads to deterioration of environment. An integral part of industrial activity is the production of effluent. Sugar industries, which play an important role in economic development of our nation are also discharging a large amount of waste water as effluent. Diverse sugar industry effluents disposed of in soil and water cause major pollution problems in terrestrial ecosystem. Sugar industries cause organic pollution. Sugar industry effluents, when not treated properly, have an unpleasant colour and odour. They are released into the environment. The industrial effluents are generally considered harmful but sometimes used for irrigating various crops, (Nath *et al.*, 2009 and Malaviya *et al.*, 2007) in order to meet the demand of water. Greengram is one of the important pulse crop in India. It has been reported that greengram has been cultivated in India since ancient times. Seed germination is a critical stage that ensures reproduction and controls the dynamics of plant populations, thus it is a critical test of probable crop productivity. In view of such perspectives, the present investigation was conducted to evaluate the impact of different concentrations of sugar industry effluent on seed germination.

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2.MATERIALS AND METHODS

Materials

Materials used for this study were CO-6 variety greengram seeds, sugarmill effluent.

Source of seeds

Seeds CO-6 were obtained from **TNAU** Coimbatore, Tamil Nadu.

Laboratory experiments

Preparation of test solutions

Preparation of different concentrations of effluent

The collected effluent sample from the outlet of sugar industry was treated as100 per cent raw effluent. Different concentrations (10, 25, 50, 75 and 100 per cent) of sugarmill effluent were prepared freshly by using tap water whenevernecessary. They were used for both germination studies and field experiments.

Control	:	Tap water
10%	:	10 ml effluent + 90 mL water
25%	:	25 ml effluent + 75 mL water
50%	:	50 ml effluent + 50 mL water
75%	:	75 ml effluent + 25 mL water
100%	:	Raw effluent

Germination studies

Germination study was conducted with African marigold seeds treated with effluent. The seeds of greengram were surface sterilized with 0.2 per cent of $HgCl_2$ for two minutes and they were thoroughly washed with tap water. The seeds were equispacially arranged in plastic cup filled with garden soil and they were treated with different concentrations (10, 25, 50, 75 and 100 per cent) of sugarmill effluent. The control set was maintained by using tap water. Five replicates were maintained for each treatment. On the seventh day, the germination percentage, shoot length, root length, were also analysed.

Sugar industry effluent

For the present study, sugar industry effluent was collected from EID-PARRY Pvt. India Limited, Nellikuppam, Cuddalore district. The sample was collected in a pre-cleaned tin and bottles. Standard procedure (BIS) was followed for the collection nd analysis of sugar industry effluent. The physico-chemical properties of the effluent namely pH, Dissolve Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolve Solids (TDS), Total Suspended Solids (TSS), Total Hardness (TH), Sodium, Potassium, Calcium, Chloride and Sulphate etc. were analysed.

Experimental set-up

Ten seeds of greengram were taken into a container. Plant seeds were spread on equal distance in container and sugar industry effluent water was taken in different concentrations. Then the water is poured into the container and left there for 24 hours so that seeds can start germination. After that the water is drained out and the data is recorded. Parameters like germination percentage was recorded on different periods of growth. First recording was done after 12 hr. and subsequent recordings were taken after 1 day interval till 7th day. Visible radical growth and emergence of hypocotyls and the cotyledons was noted to determine germination. Visible radical growth and emergence of hypocotyls and the cotyledons was noted to determine germination. The same experiment was done in two ways one with 10 number of seeds soaked in effluent water diluted with pot water.

Seedling length

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

3.RESULTS AND DISCUSSION

Analysis physico-chemical parameter of sugarmill effluent

The collected sugarmill 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 (2012). Standard methods for examination of water and wastewater. 22nd edition American Health Association, Washington, DC.

Table 1. Physico–chemical analyses of sugarmill effluent

S. No.	*Parameter*	Values effluent (Untreated)	Values effluent (Treated)
1	Colour	Dark brown	Straw yellow
2	Odour	Unpleasent odour	Sugar syrup smell
3	pH	4.58	7.31
4	Turbidity (NTU)	17.3	14.5
5	Total suspended solid @ 105°C (mg/L)	42	12
6	Total dissolved solid 180°C (mg/L)	1124	658
7	Total solids (mg/L)	760	700
8	Oil and grease (mg/L)	2.0	1.0
9	Total residual chlorine (mg/L)	ND	ND
10	Total Kjeldahl nitrogen (as N) (mg/L)	8.2	7.8
11	Free ammonia (as NH_3) (mg/L)	9.6	5.1
12	Biochemical oxygen demand (27°C) (mg/L)	64	32
13	Chemical oxygen demand (mg/L)	256	128
14	Copper (as Cu) (mg/L)	0.019	0.016
15	Zinc (as Zn) (mg/L)	0.056	0.054
16	Selenium (as Se) (mg/L)	ND	ND
17	Dissolved Phosphate (as P) (mg/L)	2.6	2.1
18	Sulphide (as S) (mg/L)	1.0	1.1
19	Sodium (as Na) (mg/L)	293.5	108.9
20	Potassium (K) (mg/L)	13.9	28.9
21	Sulphate (SO_4) (mg/L)	12	11

Germination percentage

Germination refers to the initial appearance of the radical by visualobservation. Its percentage was calculated by using the following formula:

$$\text{Germinationpercentage} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

Germination percentage values of greengram under sugar industry effluent diluted with pot water irrigation are presented in (Fig. 1). The germination percentage varies in different effluent concentrations. It was found to be (100% germination in control and up to 10% concentration, 65% germination in 75% and 50% concentrations 70% of seed germination, 25% concentrations 85% of germinated in effluent treatment respectively. When the pot water is used for dilution, the seeds were not affected. But in high concentration variation was seen clearly. Even the seed cover is not opened, and the colour of seed also changed to black. The higher concentration didn't favour. The seed for germination. The presence of extreme high acidic load inhibited the germination and declined the germination percentage. He mechanism involved in delayed germination might be linked with the reduced activity of several enzymes (Agarwal and Hemalatha, 1992). It may be also due to the amount of TDS responsible for retardation of germination and subsequent growth of young seedlings, which would disturb the osmotic relation of the seeds with effluent water and thus reduce the amount of water absorbed (Akbar *et al.*, 2009). The increase in germination percentage over control at lower concentrations indicates the stimulation of physiologically inactive seeds of the lot due to the treatment as suggested by (Lenin and Thamizhiniyan, 2009). It may also be due to the reduction in level of toxic metabolites by dilution and better consumption of nutrients present in the effluent (Kannan, 2001). Root length, shoot length values of greengram under sugar industry effluent are presented in (Figs. 2 and 3). The highest reading was observed in 10% effluent treatment the lowest reading was observed in 100% of effluent treatment

Depending on the concentration of effluent the shoot length, dry matter and germination percentage showed variation. The results were inversely proportionate with the effluent concentration. The shoot length, root length and 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 and germination value decreases with the increase in concentration of effluent.

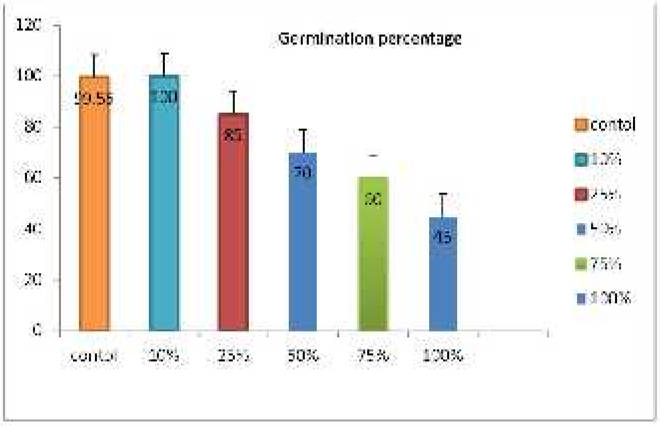

Fig. 1. Effect of different concentrations of sugarmill effluent on seed germination percentage of greengram (*Vigna radiata* L.) seedlings

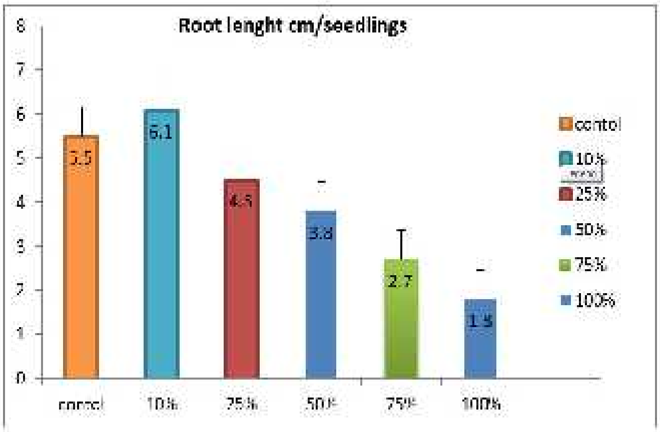

Fig. 2. Effect of different concentrations of sugarmill effluent on root length of greengram (*Vigna radiata* L.) seedlings

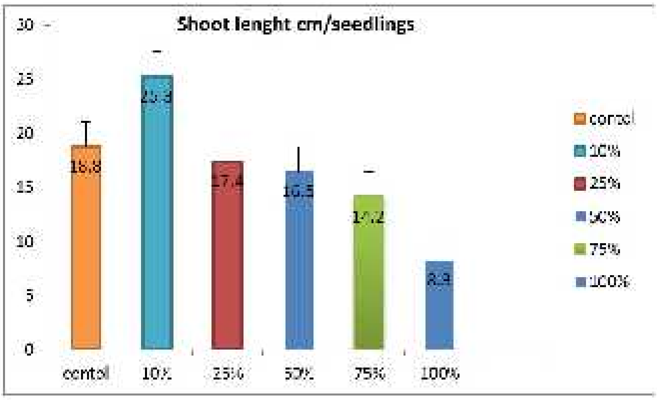

Fig. 3. Effect of different concentrations of sugarmill effluent on shoot length of greengram (*Vigna radiata* L.) seedlings

4.CONCLUSION

It can be concluded that sugar industry effluent is one of the alternative resource to meet the water demand for agriculture practices. On the basis of the above experiment it can be suggested that sugar industry effluent should be treated to reduce the concentration of pollutants. Then the effluent can be used for irrigation purpose in cultivating crops only after proper dilutions. Diluted effluent water is not effecting the rate of germination.

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