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GERMINATION AND SEEDLING GROWTH OF *VIGNA RADIATA* L. UNDER SUGAR MILL EFFLUENT STRESS

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Abstract: The present research work has been studied the seed germination and growth of *Vigna radiata* (L.) Wilczek. Vigna seeds were raised in petriplates irrigated with various concentrations of sugar industry effluent (control, 10, 25, 50, 75 and 100%). At lower dilutions, the *Vigna radiata* showed favourable effect on seed germination, seedling growth and fresh and dry matter production over control. Among them 100% concentration of effluent caused inhibitory effect. This toxicity might be due to excess of nutrients, beyond the limits of tolerance.

Keywords: *Vigna radiata*, Effluent, Seed germination, Inhibitory.

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INTRODUCTION

Industrialization is a significant tool for the growth and development of any nation. The industrial activity has explored world-wide. This time it has become a matter of major concern in the degradation of the environment. Water resources are affected by industrial pollution extremely. Pollution caused by industrial effluents is a serious problem in throughout the world. The sugar mill effluent is having a higher amount of organic and inorganic elements. They contain higher contents of total hardness, total dissolved solids, biological oxygen demand, chemical oxygen demand, calcium, magnesium, sodium, iron and sulphate. In addition to that, some traceable amount of heavy metals such as zinc, copper and lead were also exists in the effluent (Borale et al. 2004). Sugar industry effluents are commonly used for irrigation, so it is necessary to understand the response of industrial effluent to crops depends on it (Santiago and Bolan 2006; Ramana et al. 2002). Sugar mill effluent that has not been treated properly has an unpleasant odor when discharged into the environment. The effluents not only affect the plant growth but also degrade the soil properties when used for irrigation (Patel et al. 2004). A laboratory experiment was designed to know the effect of different concentration (0-100%) of sugar effluent on seed germination and growth in *Vigna radiata*.

MATERIALS AND METHODS

Sugar industry effluent samples were collected from the point of discharge of sugar factory situated in Uttar Pradesh, India. The effluent sample was collected in glass botel and stored in refrigerator. The effluent was analyzed for its various physico-chemical parameters as per the method of American Public Health Association. Seeds of *Vigna radiata* were obtained from Seed Certification Office, Meerut. Healthy seeds of uniform size were selected and washed with distilled water. The various concentrations 10, 25, 50, 75 and 100% of sugar mill effluent solution were prepared and used for experiment. *Vigna radiata* seeds were spread equidistantly on each sterilized Petri dish lined with blotting paper and then irrigated with 5 ml of the different concentrations of sugar industry effluent. Each treatment consisted of three replicate plates with twenty seeds per plate. Data were taken from three replicates of seedling on 7th day old seedlings. Five plants were collected from each parameter such as plumule length, radicle length, fresh weight and dry weight of the crop plant. The number of seed germination was counted on 7 day and total percentage was calculated by using the following formula.

Total seed germination (%) = total number of seed s germinated X 100/Total number of seed taken

Fresh weight (g/plant) was taken with the help of a digital balance. The collected plant materials were kept in hot air oven at 80°C for 24 hours and their dry weight (g/plant) were taken by using a digital balance.

RESULT AND DISSCUSTION

The physico-chemical characterisation of sugar mill effluent is shown in Table 1. From the Table 1, it is clear that, the sugar mill effluent was brownish in colour and acidic in nature. The pH was relatively low due to the use of phosphoric acid and sulphur-dioxide during clarification of sugar cane juice (Palharyal 1993). The pH is a crucial factor in the establishment of algal blooms that makes the water unfit for irrigation. If this water is used for irrigation over agricultural land, the soil becomes acidic resulting in poor growth and yield of crop.

It contain considerable amount of solids, biological oxygen demand and chemical oxygen demand. It appears that high concentration of potassium, chloride, sodium, sulphate ions and high amount of biological oxygen demand and chemical oxygen demand contribute to the toxicity of the effluent (Sexena 2012).

The highest germination percentage was observed at 10% sugar mill effluent concentration (Table 2). The percentage of seeds germination decreases as the effluent concentration increases. At higher concentrations, the germination percentage was gradually decreased from 25 to 100% raw effluent. It may also be due to the disturbance of the osmotic relations of the seed and water, thus reducing the amount of absorbed water and retarding seed germination. May be the germinated seeds will not get any oxygen due to organic and inorganic chemicals present in the effluent. The increase in germination percentage might be due to the decline level of toxic metabolites by dilution and better usage of nutrients appeared in the effluent (Kannan 2001; Kaushik et al. 2005). The reduction in seed germination at higher concentrations may also be due to the excess amount of minerals and nutrients exist in the effluent (Kumar 1999). Reduction in seed germination percentage at higher concentration of effluent may be due to the higher amount of solids present in the effluent, which causes changes in the osmotic relationship of the seed and water. The reduction in the amount of water absorption take place with results in to reduction of seed germination due to enhanced effluent salinity (sing et al. 2005). Thus the percentage germination of each seed decreased with increase in effluent concentration.

The increment in seedling growth by the lower concentration of effluent might be due to the presence of plant nutrient in the effluent. There was slight and gradual reduction in plumule length and radicle length from 25-100% concentration of effluent in seedlings. In *Vigna radiata* the plumule length and radicle length significantly increased in 10% concentration of effluent while decreased in 25, 50, 75 and 100% concentrations of the effluent in comparison to control.

The fresh weight and dry weight of plant samples grown in various concentrations of effluent were presented in Table 3. The fresh weight and dry weight were also increased at lower concentrations and decreased at the higher concentrations of sugar mill effluent. The presence of optimum level of nutrients in the lower concentrations of sugar mill effluent might have increased the fresh weight and dry weight of crop plants. The decrease in shoot length, root length, fresh weight and dry weights were recorded 25% concentrations of effluent irrigation. It may be the presence of toxic pollutants in the effluent. The reduction in dry weight of plant materials may be due to the poor growth under effluent irrigation (Balashouri 1994).

CONCLUSION

From these experiments it can be concluded that, low concentration 10% had stimulatory effect on germination and growth of *Vigna radiata*. But the higher concentration of effluent is toxic to the plant growth. It is recommended that only after treatment and dilution of sugar mill effluent be used for irrigation purpose.

TABLE 1: Physico-chemical properties of sugar mill effluent.

S.No.	Properties	Row Effluent
1	Colour	Brown
2	Odour	Decaying molasses smell
3	pH	4.56
4	E.C.(dS/m)	2.23
5	Temperature (°C)	32
6	Total Dissolved Solids (mg/l)	1886
7	Total Solids (mg/l)	2298
8	BOD (mg/l)	1826
9	COD (mg/l)	2439
10	Sulphate (mg/l)	738
11	Chloride (mg/l)	33
12	Calcium (mg/l	158
13	Magnesium (mg/l)	545
14	Iron (mg/l	45
15	Sodium(mg/l)	49

All parameters except colour, odour, pH, EC and temperature are expressed in mg l^{-1}

TABLE 2: Effect of different concentrations of sugar mill effluent on seed germination, plumule length (cm) and radical length (cm) of *Vigna radiata* L.

Effluent Conc. %	Germination %	Plumule length (cm)	Radicle length (cm)
0	90±0.17	3.16±0.27	2.56±0.31
10	92±0.04	3.68±0.31	2.78±0.12
25	79±0.26	2.83±0.14	2.33±0.02
50	75±0.11	2.54±0.05	1.83±0.29
75	63±0.19	1.82±0.22	1.51±0.18
100	51±0.09	1.36±0.08	1.42±0.15

Values are mean of three replicates

± Standard deviation

TABLE 3: Effect of different concentrations of sugar mill effluent on fresh weight (g), dry weight (g) and moisture content % of *Vigna radiata* L.

Effluent Conc. %	Fresh wt. (g)	Dry wt. (g)	Moisture content %
0	2.21±0.020	1.36±0.026	72.66±0.63
10	2.59±0.011	1.41±0.005	75.22±1.58
25	2.06±0.005	1.07±0.011	70.37±1.41
50	1.58±0.019	0.87±0.020	71.41±1.35
75	0.91±0.021	0.28±0.003	68.64±0.93
100	0.44±0.008	0.15±0.016	64.33±1.68

All values are mean of three replicates

± Standard deviation

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