

Response of Pea (*Pisum sativum*) to Sugar Industry Effluent Treatment

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Abstract—Sugar mills play a major role in polluting the soil and water bodies by discharging a large amount of waste water as effluent. The present research work has been carried out to assess the impact of sugar mill effluent applied in different dilutions i.e 25%, 50%, 75% and 100% along with control on pea (*Pisum sativum*) seeds to investigate their effect on seed germination and growth parameters such as germination percentage, shoot length, root length, seedling vigour, plant fresh weight and dry weight by pot culture. The low effluent pH (4.3), Total dissolved solids (TDS, 1990 mg/L), Biochemical oxygen demand (BOD, 850 mg/L) and Chemical oxygen demand (COD, 2920 mg/L) indicated the high inorganic and organic content with an acidic load. The present study was carried out with the aim that sugar mill effluent shows positive or negative effect on plant growth. The result indicated that sugar mill effluent did not show any inhibitory effect on germination percentages and germination values at lower concentration in the seeds tested.

Keywords— Sugar mill effluent, *Pisum sativum*, seed germination, seedling vigour.

I. INTRODUCTION

Industrial activities generate a wide variety of waste effluents which are generally discharged into water courses. Among the effluent discharging industries such as fertilizer, pulp and paper, textile, sugar mills, tanneries, distilleries etc, sugar mills play a major role in polluting the water bodies because it contains large quantities of chemical elements. India is the second largest producer of sugar in the world after Brazil with 550 sugar mills and 220 million tons cane per year and total sugar production 13.5 million tons per year (Kaur *et al.*, 2010). Sugar industry effluent contains several organic and inorganic contents in different concentrations. The effluents also alter the physico-chemical characteristics, and flora and fauna of receiving water bodies. Use of sugar mill effluents for agricultural purposes is a highly warranted utility of water pollutants proposition. The continuous use of such type of effluents harmful affects the crops when used for irrigation. The

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

Use of industrial waste water for irrigation purposes has emerged an important way to utilize its nutrients and removal of its pollution load by growing tolerant plant species. Efforts have been made by different workers to determine the effect of sugar mill effluent on seed germination of various crops such as paddy (Samuel and Muthukkaruppan, 2011), *Vigna angularis*, *Vigna cylindrical* and *Sorghum cernum* (Doke *et al.*, 2011), *Brassica campestris* (Beg *et al.*, 2010), wheat, barley, pea, black gram and mustard (Nath *et al.*, 2007), rice (Rath *et al.*, 2013), fenugreek (Kamlesh and Kidwai, 2016), Black gram (Vaithyanathan *et al.*, 2014; Elayaraj, 2014), cow pea (Mycin, 2014) and *Raphanus sativus* (Vijayaragavan *et al.*, 2011). Plant responses to sugar mill effluent has been studied and reviewed extensively by (Vaithinathan *et al.*, 2014; Elayaraj 2014; Kamlesh, 2016).

The present study was conducted to evaluate the impact of different concentrations of sugar mill effluent on seed germination and other growth parameters of Pea (*Pisum sativum*).

II. MATERIALS AND METHODS

An effluent sample was collected from the outlet of the sugar mill situated at Bhali, Rohtak (Haryana co-op. sugar mills ltd), Haryana, India during the month of November. Effluent sample was collected in precleaned, sterilized plastic container and were stored at 4°C for physico-chemical analysis. The methodology of APHA (2010) was followed for physico-chemical analysis of the collected effluent. The seeds of pea (*Pisum sativum*) were procured from certified local supplier and were surface sterilized by following the method of Aery (2010) prior to germination studies. Different concentrations of effluent (25%, 50%, 75% and 100%) were prepared by using distilled water along with control in triplicate. Ten healthy seeds were sowed in each pot of different concentrations to study the response of test plant. Germination percentage was recorded

after 7 days. Growth of the root and shoot length were measured after 14 days with the help of meter scale. Fresh and dry weight of test plants was determined on a digital balance.

Statistical analysis was done by using SPSS software ver. 20. Data were analyzed for mean, standard deviation and one way analysis of variance. ANOVA is used to compare these data between treated seedlings and control seedlings. P values less than 0.05 was considered to be significant.

Table.1: Physico-chemical analysis of effluent

| S.No. | Parameters | Sugar Effluent |
|-------|-------------------------|----------------|
| 1 | Colour | Dark brown |
| 2 | Odour | Decaying smell |
| 3 | pH | 4.3 |
| 4 | Temperature | 34°C |
| 5 | EC (µS) | 3.2 |
| 6 | TS (mg/l) | 2400 |
| 7 | TDS (mg/l) | 1990 |
| 8 | TSS (mg/l) | 410 |
| 9 | COD (mg/l) | 2920 |
| 10 | BOD (mg/l) | 850 |
| 11 | Total hardness (mg/l) | 210 |
| 12 | Total alkalinity (mg/l) | 320 |
| 13 | Chloride (mg/l) | 190 |

III. RESULTS AND DISCUSSION

The physico-chemical analysis of sugar mill effluent is given in Table-1.

The characterization of the effluent revealed that it is dark brown in colour which could be due to presence of melanoidin which is the product of sugar amine condensation and decaying smell due to presence of indole and sulphure compounds (Rath *et al.*, 2010). According to previous studies pH plays a significant role in toxicity (Truman *et al.*, 1986, Martin, 1987). The pH of the effluent was found acidic in nature having pH of 4.3. The acidic nature of sugar effluent might be due to the use of sulphuric acid and phosphoric acid during sugarcane juice clarification (Memon *et al.*, 2006, Ayyasamy *et al.*, 2008). The value of total solids, total dissolved solids and total suspended solids were 2400 mg/l, 1990 mg/l and 410 mg/l respectively. The effluent had higher BOD, 850 Mg/l and COD, 2920 mg/l. The higher concentration of BOD and COD indicated the higher concentration of organic and

inorganic substances in the effluent. Further the values of total hardness (TH), total alkalinity (TA) and chloride were 210 mg/l, 320 mg/l and 190 mg/l respectively. The presence of high amount of COD, BOD, suspended solids, total hardness were also recorded by Baruah *et al.*, 1996; Medhi *et al.*, 2008.

The observation made on the effect of sugar mill effluent on growth parameters of pea (*Pisum sativum*) are presented in Tables (2-7). The results clearly indicate that at lower concentrations test plant responded in a better way in comparison of control showing the supply of essential nutrients needed for plant growth and metabolism. The higher concentration of effluent decreased the germination studies parameters. Similar observations were obtained by Singh and Mishra (1987), Verma and Verma (1995), Lakshmi and Sundaramoorthy (2000), Rajesh *et al.*, (2013) and Vaithyanathan *et al.*, (2014) while studying the effect of various industrial effluent on some agricultural crops. The increase in germination study parameters at lower concentration may be due to presence of growth promoting nature of nutrients present in the diluted effluent (Sahai *et al.*, 1979). The reduction in growth parameters at higher concentrations of effluent may be due to the presence of excess amount of elements present in the effluent which inhibit the seed germination and growth by interfering the metabolic activities (Biradar *et al.*, 1989; Srivastava *et al.*, 1988; Verma and Verma, 1995; Kaushik *et al.*, 2004).

Table.2: Effect of different concentrations of effluent on germination percentages

| S. No. | Concentration (%) | Germination (%) | Reduction /Increase (%) |
|--------|-------------------|-----------------|-------------------------|
| 1 | Control | 56.7±5.77 | - |
| 2 | 25 | 70±10.00 | 23.45 |
| 3 | 50 | 76.7±5.77* | 35.27 |
| 4 | 75 | 53.3±5.77 | -6.0 |
| 5 | 100 | 43.3±5.77 | -23.63 |

* Indicates- significant

Table.3: Effect of different concentrations of effluent on seedling vigour

| S. No. | Concentration (%) | Vigour | Reduction /Increase (%) |
|--------|-------------------|--------------|-------------------------|
| 1 | Control | 1338.3±323.8 | - |
| 2 | 25 | 1401.3±191.5 | 4.71 |
| 3 | 50 | 1667.7±72.6 | 24.61 |
| 4 | 75 | 952.6±47.9 | -28.82 |
| 5 | 100 | 678.3±31.9* | -49.32 |

* Indicates- significant

Table.4: Effect of different concentrations of effluent on shoot length (cm)

| S. No. | Concentration (%) | Shoot length | Reduction (%) |
|--------|-------------------|--------------|---------------|
| 1 | Control | 10.2±0.20* | - |
| 2 | 25 | 9.3±0.15* | 8.82 |
| 3 | 50 | 9.6±0.26* | 5.88 |
| 4 | 75 | 7.8±0.10* | 23.53 |
| 5 | 100 | 7.3±0.11* | 28.43 |

* Indicates- significant

Table.5: Effect of different concentrations of effluent on root length (cm)

| S. No. | Concentration (%) | Root length | Reduction /Increase (%) |
|--------|-------------------|-------------|-------------------------|
| 1 | Control | 10.9±0.06 | - |
| 2 | 25 | 10.7±0.10 | -1.83 |
| 3 | 50 | 11.5±0.23* | 5.50 |
| 4 | 75 | 10.8±0.15 | -0.92 |
| 5 | 100 | 9.2±0.06* | -15.6 |

* Indicates- significant

Table.6: Effect of different concentrations of effluent on fresh weight (mg)

| S. No. | Concentration (%) | Fresh weight | Reduction /Increase (%) |
|--------|-------------------|--------------|-------------------------|
| 1 | Control | 0.21±0.01 | - |
| 2 | 25 | 0.23±0.01 | 9.52 |
| 3 | 50 | 0.18±0.01 | -14.28 |
| 4 | 75 | 0.14±0.02* | -33.33 |
| 5 | 100 | 0.11±0.00* | -47.62 |

* Indicates- significant

Table.7: Effect of different concentrations of effluent on dry weight (mg)

| S. No. | Concentration (%) | Dry weight | Reduction /Increase (%) |
|--------|-------------------|------------|-------------------------|
| 1 | Control | 0.05±0.01* | - |
| 2 | 25 | 0.07±0.00 | 40 |
| 3 | 50 | 0.03±0.01 | -40 |
| 4 | 75 | 0.02±0.00* | -60 |
| 5 | 100 | 0.01±0.00* | -80 |

* Indicates- significant

IV. CONCLUSION

In the present study sugar mill effluent was studied to know its effect on initial growth parameters such as germination percentage, seedling vigour, shoot length, root length, fresh

and dry weight of pea (*Pisum sativum*). From the present work, it is concluded that lower concentration (25%-50%) of sugar mill effluent promoted the growth while higher concentration inhibited the seedling growth.

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