PHYSIOLOGICAL BEHAVIOR OF DOLICHOS LABLAB L. DURING SEED GERMINATION AND EARLY SEED GROWTH, SUBJECTING TO DAIRY EFFLUENT STRESS.

P. Madhu, N. K. Hemanth Kumar, Shobha Jagannath
Department of Studies in Botany, University of Mysore, Manasagangotri, Mysore, 570006, Karnataka, India

Abstract- In the present investigation an attempt was made to understand Physiological behavior of Dolichos lablab L. subjecting to dairy effluent stress. The physio-chemical data indicates that effluent is rich in organic content. The seeds were subjecting to different concentrations of effluent (viz, 25, 50, 75 and 100 %) in the cups filled with soil. Germination percentage, vigour index and tolerance index are found to be decreased significantly except in 25% concentration when compare to control. On the other hand phytotoxicity decreased at 25% concentration of the effluent. The maximum value of fresh weight was observed in 25% concentration, on the contrary the dry weight was found to be increased as the concentrations of the effluent increased. The length of the plumule and radicle decreased significantly as the concentration of the effluent increased except in 25% concentration. Physiological parameters such as chlorophyll a, b, total chlorophyll and carotenoid content were found to be decreased as the concentration of the effluent increased except in 25% concentration. The total protein, total carbohydrate content was found to be significantly decreased in root-shoot axis; however it increased in cotyledons as the concentration of the effluent increased except in 25% concentration. The total phenol content was found to be decreased both in root-shoot axis and cotyledons as the concentration of the effluent increased. These results reveal that mobilization of seed reserve is impaired may be due to high level of total dissolved so ids in the effluent by disturbing the activity of enzymes necessary for above parameters.

Key words: Dairy effluent, germination, total protein, total phenol

I. INTRODUCTION

Pollution is an undesirable change in physical, chemical and biological characteristics of our environment that may or will harmfully affect the human life and living conditions (Selvi et al. 2007). The agents which cause environmental pollution are called pollutants. Among the various types of pollutants, water pollution by waste discharge of industries offers great threat to aquatic and agro ecosystems by affecting it directly or indirectly and so ultimately the human life (Hussain et al. 1982). Due to lack of effluent treatment facilities and proper disposal system of waste water, water bodies are getting polluted day by day and causing adverse effect on soil, water, agriculture, flora and fauna due to presence of toxic and persistent chemicals (Selvi et al. 2012). The water resources are most often affected by anthropogenic activities and also from industries. With the exponential increase in the number of industries, there has been a substantial increase in generation of industrial wastewater, which is discharged either into open land or nearby aquatic ecosystems. This activity promotes varying degree of pollution load in water, soil and air (Banupriya and Gowrie, 2012). Industrialization is an important tool for the development of any nation. Consequently, the industrial activity has expanded so much all over the world. Today, it has become a matter of major concern in the deterioration of the environment. With the rapid growth of industries (Dairy, sugar, paper, tannery, textile, sago and dye industries) in the country, pollution of natural water by industrial waste water has increased tremendously. Though industrialization contributes economical development, most important natural resources like water and soil are commonly polluted with by-products, waste materials and non-utilized parent chemical compounds. These in-turns ultimately affect the agriculture production and food security. India is an agriculture based country and a major user of water resource for irrigation. But there is a great demand for water for irrigation while gallons and gallons of effluents are let out into water sources untreated. The most important effluent discharging industries are thermal power plants, paper mills, textiles, distilleries, fertilizer unit, electroplating plants, tannery industries, sugar mills, and sago factories (Selvi et al. 2012).

Dairy industry is one of the major food industries in India, and India ranks first among the maximum major milk...
producing nation (Sharma et al. 2011). Dairy is an industry where milk is processed and various milk products are manufactured. Dairy, in which the cleaning silos, tanks, heat exchangers, homogenizers, pipes and other equipment, engenders a large amount of effluent with a high organic load. This organic load is basically constituted by milk (raw material and dairy products), inorganic salts, detergents, sanitizers used for washing reflecting an effluent with high levels of chemical oxygen demand (COD), biochemical oxygen demand (BOD), oils and grease, nitrogen and phosphorus than the specified limits of ISI. This naturally affects the water quality as well as natural ecosystem, when effluent is discharged into the water bodies (Yakub and Bala, 2012). KMF dairy industry is located in Gejjalagere, Mandy Dist. from North of Mysore city, Karnataka, India. KMF dairy industry, Gejjalagere is one of the major milk product dairy in Karnataka. The Dairy factory is a major source of food processing waste (Britz et al. 2006). Hence in the present investigation an attempt has been made to assess the physico-chemical parameters of dairy effluent and its effect on early seed germination and growth of Dolichos lablab variety SOUDHA.

II. MATERIALS AND METHODS

The seed samples of certified varieties of Dolichos lablab of variety SOUDHA were procured from Arjun agro agencies, Mysore, Karnataka, India. The dairy effluent sample was collected from Gejjalagere co-operative milk producers, Gejjalagere, Mandy district, Karnataka, India. The effluent was stored in pre cleaned plastic container, under dark condition, which was stored in a refrigerator at 4°C until used. The various physico chemical parameters such as pH, chlorides, alkalinity, total hardness, dissolved oxygen (DO), Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), total dissolved solids (TDS), suspended solids, iron, nitrates and sulphates were analyzed as per the standard method described by (APHA, 1998). Four hundred comparably sized seeds were selected, sown in triplicates in plastics cups and filled with required garden soil. 2 seeds per each cup were sown. The seeds were treated with equal volume of various concentrations of effluents (viz. 25, 50, 75, and 100%) and distilled water as control, left as such for 8 days for germination. The germination percentage, root length and shoot length were recorded as per (ISTA, 1985). The fresh and dry weight was estimated following the method of (HUssain et al. 1982). The germination parameters like Tolerance index (Turner and Marshal, 1972), Percentage of phytotoxicity (Chiou and Muller, 1972), and Vigour index (Abdul-Baki and Anderson, 1973) were calculated. The total chlorophyll content was measured by following the method of (Arnon, 1949), carotenoids suggested by (Kirk and Allen, 1965). The total protein content was determined by following the method of (Lowry et al. 1951). Carbohydrate content was determined following the procedure of (Hedge and Hofreiter, 1962), Total Phenols were determined following the method of (Malick and Singh, 1980). The data were subjected to analysis of variance, using SPSS version 14.0 according to Tukey’s mean range test at 5% level significance (Tukey, 1949).

III. RESULT AND DISCUSSION

The physio-chemical analysis of dairy effluent is presented in the table 1. The colour of the effluent is creamy white. The pH was 10.5 (highly basic) in raw spent wash and 8 (slightly basic) in treated spent wash. The temperature of effluent was found to be 32-35°C in raw effluent and 27-28°C in treated effluent. The BOD (Biological Oxygen Demand) and COD (Chemical Oxygen Demand) values were very high in raw effluent (820 mg/l and 1475 mg/l) respectively and which were reduced in treated effluent (32 mg/l and 134 mg/l) respectively. The TSS (Total Suspended Solids) and TDS (Total Dissolved Solids) values were high in raw effluent (340 mg/l and 1080 mg/l) respectively and which were reduced in treated effluent (150 mg/l and 690 mg/l) respectively. Also nitrogen, phosphate, sulphate and magnesium content were high in raw effluent and reduced in treated effluent. The physio chemical analysis of dairy effluent clearly indicates that it is very high in inorganic and organic content. To avoid this adverse effect before the effluent is discharged to the open land, proper treatment is necessary to reduce the toxic level. Our findings are in line those of earlier results (Yakub and Bala, 2012). The physio-chemical parameters of dairy effluent showed that the effluent was slightly basic and highly rich in COD, BOD, Sulphide, TDS and TSS. Similar results have been observed by (Kulkarni and Dharwardkar, 1998, Gaikar et al. 2010, Banupriya and Gowri, 2010, Selvi and Shravana, 2013, Sharma and Sharma 2011, Varma and Sharma, 2010 and Sharma et al. 2011).

The effect of dairy effluent on various germination parameters of Dolichos lablab such as germination percentage, root length, shoot length, fresh weight, dry weight, seed vigor index, tolerance index and percentage of phytotoxicity are represented in the table-2. The percentage of germination was found to be decreased with increase in concentration of effluent except in 25% concentration. An analysis of variance indicates that there was a significant difference in the germination percentage of Dolichos lablab seedlings between control and all other concentrations. The germination percentage was high in 25% concentration (98.08%) and low in 100 % concentration (64.02 %). The effect of different concentration of dairy effluent on vigor index of Dolichos lablab seedlings showed significance difference between control and all other concentration. The vigor index was higher in 25% concentration (4428.33) and lower in 100% concentration (1277.16).

The effect of different concentration of dairy effluent on tolerance index of Dolichos lablab seedlings showed significance difference between control and all other concentration. The tolerance index decreased as the concentration of the effluent increased, when compared to control except in 25% concentration. The percentage of
tolerance index was maximum in 25% concentration (108.83) and minimum in 100% concentration (54.12). The mean value of Phytotoxicity in *Dolichos lablab* seedlings at different concentration of effluent was found to be significantly different. The percentage of phytotoxicity was high in 100% concentration (36.65) and low in 25% concentration (-24.06). The root and shoot length decreased significantly as increased in effluent concentration from 25% to 100% concentration. The root length and shoot length was maximum in 25% concentration (21.14 cm and 24.82 cm) respectively and minimum in 100% concentration (10.13 cm and 9.22 cm) respectively and from 50-100% concentration the root and shoot length was decreased with increasing in concentration of effluent, (Table 1).

The higher concentrations of effluent inhibited the root and shoot length and showed a decreasing trend as the effluent concentration increased. Similar results were observed by (Gaikar et al. 2010) in Soyabean; (Kulkarni and Dharwadkar, 1998) in Wheat seeds; (Banupriya and Gowrie, 2010) in different plant species; (Selvi et al. 2012) in *Phaseolus trilobus*; (Varma and Sharma, 2012) in Wheat. In this investigation, germination percentage gradually decreased from 50% to 100% concentration as the concentration of dairy effluent increased. Germination percentage was inhibited at higher concentrations, due to higher osmotic pressure because of high do se. Osmotic pressure of the effluent at higher concentration of total salts makes inhibition more pronounced and prominent. At higher concentration (above 50%) of effluent the germination was inhibited, this is may be due to high levels of total dissolved solids, which may enhance the salinity and conductivity of the solute absorbed by the seeds before germination (Varma and Sharma, 2012). Similarly inhibitory effects of dairy effluent have also been reported in Soyabean by (Gaikar et al. 2010); in Wheat seeds by (Kulkarni and Dharwadkar, 1998); in *Triticum aestivum L.*, by (Anoop Singh et al. 2002); in Ragi by (Lakshmi and Sundaramoorthy, 2000); in Wheat by (Koushik et al. 2005); in *Phaseolus trilobus* by (Selvi and Sharavana, 2013); in *Glycine max* by (Sharma and Sharma, 2013). Decrease in vigour index has also been observed by (Banupriya and Gowrie, 2010) in different plant species; (Hassan et al. 2013) in Country bean due to textile dyeing effluent; (Manu et al. 2012) in Cow pea. The tolerance index was high at lower concentration and low at higher concentration. The tolerance index was higher in 25% effluent concentration and lower in 100% effluent concentration. Similar observation has been reported by (Banupriya and Gowrie, 2010) in different plant species; (Mehta and Bhardwaj, 2012) in *Vigna radiata* and *Cicer arietinum* due to effect of industrial effluent; (Selvi et al. 2012) in Ground nut due to effect of tannery effluent; (Narain et al. 2012) in *Cicer arietinum* due to effect of distillery effluent; (Dhanum and Arulbalchandran, 2009) in Ground nut due to effect of Briquetting and Carbonisation plant effluent; (Indra and Mycin, 2009) in *Vigna radiata* due to effect of tannery effluent.

The toxicity of the effluent increased gradually with increase in effluent concentration therefore phytotoxicity showed a reverse trend. The maximum percentage of phytotoxicity was observed in 100% concentration and minimum in 25% effluent concentration. Similar findings have been observed by (Varma and Sharma, 2012) in Wheat; (Banupriya and Gowrie, 2010) in different plant species (Indra and Mycin, 2009); in *Vigna radiata* due to effect of tannery effluent. The effect of different concentration of dairy effluent on fresh weight and dry weight in *Dolichos lablab* seedlings showed significance difference between control and all other concentrations (Table 1). The fresh weight was lower as the concentration of the effluent higher when compared to control except in 25% concentration. As the concentration of the effluent increased, the dry weight was increased when compared to control except in 25% concentration. The fresh weight was higher in 25% concentration (1.85 mg/g F. Wt.) and lower in 100% concentration (1.17 mg/g F. Wt.). The dry weight was higher in 100% concentration (0.15 mg/g F. Wt.) and lower in 25% concentration (0.08 mg/g F. Wt.). The fresh weight decreased with increased in concentration of effluent. The maximum fresh weight was observed in 25% concentration and minimum in 100% concentration of effluent. The similar results has been reported by (Indra and Mycin, 2009) in *Vigna radiata* due to effect of tannery effluent; (Narain et al. 2012) in *Cicer arietinum* due to effect of distillery effluent; (Selvi et al. 2012) in Ground nut due to effect of tannery effluent; (Dhanum and Arulbalchandran, 2009) in Black gram due to effect of tannery effluent. The dry weight was increased with increase in concentration of effluent. The maximum dry weight was observed in 100% concentration and minimum in 25% concentration.

Effect of Dairy effluent on pigment content of *Dolichos lablab* was represented in the Table 3. There was a significant reduction in the chlorophyll 'a' of *Dolichos lablab* leaves when seeds were treated with 25% to 100% concentration of effluent. The seedlings show decrease in chlorophyll 'a' from 0.241 to 0.09 mg/g F. Wt. at 50% to 100% concentration respectively. However the higher value of chl ‘a’ content were found at 25% concentration (0.54 mg/g F. Wt.) and minimum value was found at 100% concentration (0.09 mg/g F. Wt.). There was a significant reduction in the chlorophyll 'b', the amount of chl ‘b’ decreased from 1.10 mg/g F. Wt. to 0.26 mg/g F. Wt. at 50% to 100% concentration respectively. The maximum value of chl. ‘b’ was observed at 25% concentration (2.61 mg/g F. Wt.) and minimum value was found at 100% concentration (0.26 mg/g F. Wt.). The total chlorophyll content was significantly reduced at 50% to 100% concentration of effluent. The total chlorophyll content decreased from 0.86 mg/g F. Wt. to 0.18 mg/g F. Wt. at concentration from 50% to 100% of dairy effluent concentration respectively. However the higher value of total chlorophyll content was observed in 25% concentration (2.02 mg/g F. Wt) and the lower value was observed at 100% concentration (0.18 mg/g F. Wt.).The carotenoid content of *Dolichos lablab* leaves were significantly reduced at 50% to 100% concentration of effluent (Table 3). The carotenoid content decreased from 0.05 to 0.02 ± 0.0002 mg/g F. Wt. at
concentration from 50% to 100% of dairy effluent respectively. However the higher value of carotenoid content was observed in 25% concentration (0.05 mg/g F. Wt.) and the lower value was observed in 100 % concentration (0.02 mg/g F. Wt.). In present study, chl ‘a’, chl ‘b’, total chlorophyll and carotenoid were significantly lower in all the concentrations compared to 25% concentration. Similar results have been reported by (Selvi and Sharavana, 2013) in Phaseolus trilobus; (Banupriya and Gowrie, 2010) in different plant species; (Narain et al. 2012) in Cicer arietinum due to effect of distillery effluent; (Selvi et al. 2012) in Ground nut due to effect of tannery effluent; (Nagajyothi et al. 2009) in Green gram.

Effect of different concentration of dairy effluent on total protein content of root shoot axis and cotyledons of Dolichos lablab is represented in Table 4. The total protein content was found high in cotyledon and low in root shoot axis as the concentration of the effluent increased when compared to control. In root shoot axis at 25% concentration (0.43 mg/g F. Wt.) the total protein content was increased and decreased at 100% concentration (0.223 mg/g F. Wt.). In cotyledons the total protein content was minimum at 25% concentration (0.88 mg/g F. Wt.) and maximum at 100% concentration (1.52 mg/g F. Wt.). There was no significant difference between 75% and 100% concentrations. Similar results have been reported by (Selvi and Sharavana, 2013) in Phaseolus trilobus; (Banupriya and Gowrie, 2010) in different plant species; (Selvi et al. 2012) in Ground nut due to effect of tannery effluent.

Effect of different concentration of dairy effluent on total carbohydrate content of root shoot axis and cotyledons of Dolichos lablab is represented in Table 5. In cotyledons the total carbohydrate content was maximum and in root and shoot axis it was minimum as the concentration of effluent increased. In root shoot axis at 25% concentration total carbohydrate content was maximum (44.33 mg/g F. Wt.) compared to all other treatments including control. The carbohydrate content was lower in 100% concentration (13.33 mg/g F. Wt.). At 25% concentration (76.54 mg/g F. Wt.) the total carbohydrate content in cotyledon was lower compared to all other treatments including control. At 100% concentration (123.12 mg/g F. Wt.) the carbohydrate content was observed. There was not much significant difference between control and 50% concentrations.

Effect of different concentration of dairy effluent on total phenols content of root shoot axis and cotyledons of Dolichos lablab is represented in Table 4. The total phenol content showed significant increase in both root shoot axis and cotyledons as the concentration of the effluent increased when compared to control.

As the concentration of the effluent increased, phenol content of root shoot axis and cotyledons was increased. In both root shoot axis and cotyledons of Dolichos lablab seedlings the total phenol content was maximum at 25% concentration (0.45 mg/g F. Wt. and 0.55 mg/g F. Wt. respectively) and minimum at 100% concentration (0.25 mg/g F. Wt. and 0.38 mg/g F. Wt. respectively). In cotyledons there was not much significant difference between control and 75% concentration. The present investigation has clearly shown that the treated dairy effluent affects the growth of Dolichos lablab seedling at higher concentration. Hence it is recommended to utilize the effluent for irrigation purpose only after proper dilution and dilute effluent can serve as liquid fertilizer for agricultural crops.

Table 1: Physio-chemical characteristics of raw and treated Dairy effluent.

<table>
<thead>
<tr>
<th>SL NO</th>
<th>PARAMETERS</th>
<th>RAW SPENT WASH</th>
<th>TREATED SPENT WASH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Color</td>
<td>Creamy white</td>
<td>Creamy white</td>
</tr>
<tr>
<td>2</td>
<td>Odor</td>
<td>Unpleasant</td>
<td>Unpleasant</td>
</tr>
<tr>
<td>3</td>
<td>pH</td>
<td>10.5</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>Temperature</td>
<td>32-35°C</td>
<td>27-28°C</td>
</tr>
<tr>
<td>5</td>
<td>BOD mg/l</td>
<td>820 mg/l</td>
<td>32 mg/l</td>
</tr>
<tr>
<td>6</td>
<td>COD mg/l</td>
<td>1475 mg/l</td>
<td>134 mg/l</td>
</tr>
<tr>
<td>7</td>
<td>TSS</td>
<td>340 mg/l</td>
<td>150 mg/l</td>
</tr>
<tr>
<td>8</td>
<td>TDS</td>
<td>1420 mg/l</td>
<td>840 mg/l</td>
</tr>
<tr>
<td>9</td>
<td>Oil and grease</td>
<td>9.5 mg/l</td>
<td>4.3 mg/l</td>
</tr>
<tr>
<td>10</td>
<td>Magnesium (Mg)</td>
<td>8.5 mg/l</td>
<td>2.3 mg/l</td>
</tr>
<tr>
<td>11</td>
<td>Sulphate (SO₄)</td>
<td>290 mg/l</td>
<td>65 mg/l</td>
</tr>
<tr>
<td>12</td>
<td>Nitrogen (N₂)</td>
<td>95 mg/l</td>
<td>32 mg/l</td>
</tr>
<tr>
<td>13</td>
<td>Phosphate (PO₄)</td>
<td>90 mg/l</td>
<td>60 mg/l</td>
</tr>
</tbody>
</table>
Table 2: Germination percentage, vigour index, tolerance index, phytotoxicity, fresh and dry weight, plumule and radicle length of Country bean seedlings treated with different concentrations of dairy effluent.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germination Percentage</td>
<td>95.23 ± 0.34b</td>
<td>98.08 ± 0.23a</td>
<td>87.59 ± 0.43c</td>
<td>76.38 ± 0.33d</td>
<td>64.02 ± 0.45e</td>
</tr>
<tr>
<td>Vigour index</td>
<td>3484.73 ± 1.89b</td>
<td>4428.33 ± 0.90a</td>
<td>2945.43 ± 1.48c</td>
<td>238.53 ± 0.74d</td>
<td>1277.16 ±0.69f</td>
</tr>
<tr>
<td>Tolerance index</td>
<td>100.00 ± 0.00b</td>
<td>108.83 ± 0.84a</td>
<td>94.20 ± 0.92c</td>
<td>75.05 ± 0.08d</td>
<td>54.12 ± 1.23a</td>
</tr>
<tr>
<td>Phytotoxicity %</td>
<td>0.00 ± 0.00</td>
<td>-24.06 ± 0.45e</td>
<td>2.220 ± 0.83c</td>
<td>8.023 ± 0.79b</td>
<td>36.650 ± 0.35a</td>
</tr>
<tr>
<td>Fresh weight (g/plant)</td>
<td>1.37 ± 0.18b</td>
<td>1.84 ± 0.04a</td>
<td>1.72 ± 0.03c</td>
<td>1.50 ± 0.10d</td>
<td>1.17 ± 0.03e</td>
</tr>
<tr>
<td>Dry weight (g/plant)</td>
<td>0.09 ± 0.01b</td>
<td>0.08 ± 0.027d</td>
<td>0.11 ± 0.006c</td>
<td>0.13± ± 0.005b</td>
<td>0.15 ± 0.005e</td>
</tr>
<tr>
<td>Plumule (cm)</td>
<td>19.59 ± 0.23b</td>
<td>24.82 ± 0.82a</td>
<td>17.34 ± 0.49c</td>
<td>15.40 ± 0.38d</td>
<td>9.22 ± 0.22e</td>
</tr>
<tr>
<td>Radicle (cm)</td>
<td>16.57 ± 0.30b</td>
<td>21.14 ± 0.82a</td>
<td>16.21 ± 0.43b</td>
<td>5.24 ± 0.23c</td>
<td>10.13 ± 0.26d</td>
</tr>
</tbody>
</table>

Mean ± SE followed by the same superscript are not statistically significant between the concentration when subjected to SPSS package ver. 14.0 according to Tukey’s mean range test at 5% level.

Table 3: Effect of different concentration of effluent on Chlorophyll a, b, total chlorophyll and Carotenoid content in Country bean seedlings.

<table>
<thead>
<tr>
<th>Concentration (%)</th>
<th>Chlorophyll a mg/g F.wt.</th>
<th>Chlorophyll b mg/g F.wt.</th>
<th>Total Chlorophyll mg/g F.wt.</th>
<th>Carotenoid mg/g F.wt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.34 ± 0.01b</td>
<td>1.75 ± 0.003b</td>
<td>1.36 ± 0.004b</td>
<td>0.01 ± 0.009b</td>
</tr>
<tr>
<td>25</td>
<td>0.54 ± 0.002a</td>
<td>2.61 ± 0.003a</td>
<td>2.02 ± 0.003a</td>
<td>0.05 ± 0.002a</td>
</tr>
<tr>
<td>50</td>
<td>0.21 ± 0.001c</td>
<td>1.10 ± 0.001c</td>
<td>0.86 ± 0.006c</td>
<td>0.004 ± 0.001d</td>
</tr>
<tr>
<td>75</td>
<td>0.14 ± 0.001d</td>
<td>0.95 ± 0.003d</td>
<td>0.75 ± 0.003d</td>
<td>0.006 ± 0.014c</td>
</tr>
<tr>
<td>100</td>
<td>0.09 ± 0.00e</td>
<td>0.26 ± 0.002e</td>
<td>0.18 ± 0.001e</td>
<td>0.004 ± 0.002d</td>
</tr>
</tbody>
</table>

Mean ± SE followed by the same superscript are not statistically significant between the concentration when subjected to SPSS package ver. 14.0 according to Tukey’s mean range test at 5% level.

Table 4-1: Effect of different concentration of effluent on protein content in Country bean seedlings.

<table>
<thead>
<tr>
<th>Concentration (%)</th>
<th>Root Shoot axis mg/g F.wt.</th>
<th>Cotyledon mg/g F.wt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>15.41 ± 0.008b</td>
<td>9.12 ± 0.008b</td>
</tr>
<tr>
<td>25</td>
<td>17.1 ± 0.012a</td>
<td>7.54 ± 0.014d</td>
</tr>
<tr>
<td>50</td>
<td>12.15 ± 0.017e</td>
<td>14.21 ± 0.014b</td>
</tr>
<tr>
<td>75</td>
<td>7.54 ± 0.012d</td>
<td>17.54 ± 0.017a</td>
</tr>
<tr>
<td>100</td>
<td>4.13 ± 0.014e</td>
<td>21.59 ± 0.014a</td>
</tr>
</tbody>
</table>

Mean ± SE followed by the same superscript are not statistically significant between the concentration when subjected to SPSS package ver. 14.0 according to Tukey’s mean range test at 5% level.
### Table 4-2: Effect of different concentration of effluent on carbohydrate content in Country bean seedlings.

<table>
<thead>
<tr>
<th>Concentration (%)</th>
<th>Root Shoot axis mg/g F.wt.</th>
<th>Cotyledon mg/g F.wt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>31.33 ± 0.88&lt;sup&gt;b&lt;/sup&gt;</td>
<td>89.21 ± 0.13&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>25</td>
<td>44.33 ± 0.88&lt;sup&gt;a&lt;/sup&gt;</td>
<td>76.54 ± 0.29&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>50</td>
<td>22.66 ± 0.88&lt;sup&gt;c&lt;/sup&gt;</td>
<td>89.21 ± 0.12&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>75</td>
<td>18.21 ± 0.88&lt;sup&gt;d&lt;/sup&gt;</td>
<td>98.21 ± 0.19&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>100</td>
<td>13.33 ± 0.88&lt;sup&gt;e&lt;/sup&gt;</td>
<td>123.12 ± 0.29&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Mean ± SE followed by the same superscript are not statistically significant between the concentration when subjected to SPSS package ver. 14.0 according to Tukey’s mean range test at 5% level.

### Table 5: Effect of different concentration of effluent on total phenol content in Country bean seedlings.

<table>
<thead>
<tr>
<th>Concentration (%)</th>
<th>Root Shoot axis mg/g F.wt.</th>
<th>Cotyledon mg/g F.wt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.36 ± 0.015&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.43 ± 0.014&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>25</td>
<td>0.45 ± 0.020&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.55 ± 0.020&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>50</td>
<td>0.33 ± 0.014&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.50 ± 0.008&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>75</td>
<td>0.30 ± 0.005&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.42 ± 0.012&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>100</td>
<td>0.25 ± 0.023&lt;sup&gt;e&lt;/sup&gt;</td>
<td>0.38 ± 0.208&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Mean ± SE followed by the same superscript are not statistically significant between the concentration when subjected to SPSS package ver. 14.0 according to Tukey’s mean range test at 5% level.

**REFERENCES**

23. Nagajyothis, P.C., Dinakar, N., Suresh, S., Udaykiran, Y., Suresh,


