Utilization of dairy effluent on growth of Abelmoschus esculentus L.

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Abstract **- In the present study, pot experiments were conducted to evaluate the impact of dairy effluent on certain physico-chemical properties of soil and growth of Abelmoschus esculentus L. The plants were irrigated with different concentration 20%, 40%,60%,80%,100% and tap water using as a control. The effect was seen on the germination seed and growth of the plant. The plants were measured at 5 days interval. To measure the shoot length, root length, shoot dry matter, root dry matter and chlorophyll, respectively. The results show the growth rate was increased significantly with 80% treated dairy effluent compared to 20%, 40%, 60%,100%. Thus, the dairy effluent, after proper dilutions can be used as a source of water for plant growth in irrigation purposes.**

Index Terms **- Dairy effluent, Abelmoschus esculentus L. seed germination, Total chlorophyll**

I.INTRODUCTION

Water is essential nutrient and plays a key role in human body. Any water has been contaminated by human use. Effluent is used water from any combination of domestic, industrial commercial or agricultural activities. Large amount of wastewater was discharged in the environment and aquatic areas due to increasing population of growth and industrial development activities include mining, smelting of metals, textiles, burning of fossil fuels, use of fertilizers and pesticides in agriculture, production of batteries and other metal products in industries, sewage sludge, and municipal waste disposal. Effluent is an out flowing of water or gas to a natural body of water, from a structure such as a wastewater treatment plant, sewer pipe or industrial out fall. Dairy effluent contains mostly organic waste, the dairy industry includes the transformation of raw milk in to pasteurized and sour milk, yoghurt, hard soft and cottage cheese, cream and butter products, ice creams, milk and whey powders, lactose, condensed milk.

Water plays a key role in milk processing. It is used in every step of technological lines, including cleaning, and washing, disinfection heating and cooling. The bulk of wastewater comes from manufacturing process. This effluent may be dumped directly in agricultural land, so that soils and crops act as purifying agents, or it may be subjected to biological or physicochemical treatments. These dairy sludges are relatively low in heavy metals, organic contaminants, and other constituents harmful to human and animal health, when compared to municipal sludges [5]. This alternative use of wastewater will not only prevent the waste from becoming an environment hazard but also will serve as a potential source of fertilizer if used rationally and at an appropriate concentration [15]. The present study was conducted for suitability of dairy effluent to use for irrigation purposes. The selected vegetable for this purpose was Abelmoschus esculentus L.

II. MATERIALS AND METHODS

A. Collection of seeds:
Commercially available lady´s finger seeds (Abelmoschus esculentus L.) were obtained from the Agricultural department, Kallakad.

B. Seed sterilization:
Procedure: The seeds were first washed with tap water and then surface sterilized with 0.1% mercuric chloride for 30 seconds. It was then washed several times with sterile distilled water to remove any trace mercuric chloride [13].

C. Effluent treatment:
The seeds were soaked in the corresponding effluent (diluted) sample for 30 minutes. The experiment conducted of 6 treatments by dairy effluent such as 20%, 40%, 60%, 80%, 100% and control pot without effluent treatment.

D. Growth Parameters:
The shoot lengths (cm) of the seedlings were recorded from the fifth day onwards. Fresh and dry weight (mg) shoot and root length (cm) of the seedlings were determined after 5 days. The seedlings were uprooted and washed thoroughly with distilled water and length of shoot and root length were measured. The fresh weight was taken, and the plants were then packed in paper envelops and oven dried for 36 hours at 70ºC. The dry weight of the seedlings was also recorded [13].

E. Germination percentage:
Germination refers to the initial approaches of the radical by visual observation. It was calculated by using the following formula.
Germination percentage = (No of seeds germinated)/ (Total number of seeds sown) × 100

F. Collection of dairy effluent:
The effluent sample was collected in an airtight plastic container Aavin dairy farm, located in Tirunelveli. The following physical parameters like color, pH, odor, and temperature.
1. Temperature: The effluent was mixed thoroughly, and thermometer was kept inside the sample for few seconds and the reading was noted.
2. pH: pH was measured with pH meter. Before using, it was calibrated according to instruction manual provided by the manufacturer.

G. Physiochemical analysis of effluent:
Physiochemical parameters of the dairy effluent such as total solids (TS), total suspended solids (TSS), total dissolved solids (TDS), BOD (Winkler`s method), COD (Winkler`s method), Bicarbonate content, Hardness of water (EDTA titration methods), Calcium, Chloride (Van Slyke method) and phosphates (Fiske Subbarrow method), were estimated using standard methods.

H. Physiological Activity:
Estimation of total chlorophyll by Arnon, 1949 method.

III. RESULTS AND DISCUSSION

A. Physiological parameters:
It the present investigation the color of the dairy effluents was found to be whitish grey. Color is a very important factor of the aquatic life for making food from sunlight. Thus, photosynthetic activity reduced due to dark coloration and aquatic ecosystem is totally changed. Color also affects the other parameters like temperature, BOD etc. Temperature is important for its effects on certain chemical and biological reactions taking place in water and in organisms inhabiting aquatic media and will depend upon seasons and time of sampling. No specific limit for temperature is prescribed by WHO or ISI for the water quality use for the domestic purpose. In the present investigation the temperature of the effluent was found to be 26°C.pH of the dairy effluent was found to be slightly acidic i.e., 5.81. From the past studies it is concluded that free CO2 in the water is partly responsible for the increased or initial pH reading [10].

Table No.1: Physical and Physiochemical characteristics of dairy effluent

SI.NO	PARAMETERS	VALUES
1	colour	Dirty white
2	odour	Unpleasant
3	Ph	6.14
4	Temperature(˚c)	26
5	Total solids(mg/l)	207
6	Total dissolved solids(mg/l)	102
7	Total suspended solids(mg/l)	105
8	Calcium (mg/l)	10
9	Chloride (mg/l)	1
10	Phosphate (mg/l)	8
11	BOD (mg/l)	7.5
12	COD (mg/l)	244

13	Bicarbonate content (m.e/l)	0.80
14	Hardness (mg/l)	29

The total solid concentration in waste effluent represents the colloidal form and dissolved species. In the present study the total dissolved solids present in the effluent was found to be 102 mg/l. The total solids are sum of the values of the total dissolved solids and that suspended solids. The solid varies in proportions to temperature and is inversely proportional to the water level. High concentration of total solids during summer was probably due to low level of water. In effluent, total solids, total dissolved solids, total suspended solids are composed mainly of carbonates, bicarbonates, chlorides, sulphate, phosphate, nitrate, Ca, Mg, Na, K, Mn and organic matter. Stills and other particles, polluting water increase the concentration of total solids. The present study total solids of dairy effluent is 207mg/l. Total suspended solids play an important role in water and waste water treatment. Their presence in water sample causes depletion of oxygen levels. Devi (1980) reported total plankton, which showed as taking parallelism with suspended solids. Effluent from the different industries may have the different amount of solid particulate matter. When the effluent flows through the open drainage system particulate matter is expected to show greater degree of variance. If the effluent is highly acidic then the solid may dissolved in it, therefore it is necessary to evaluate effluent for the particulate matter [8]. In the present study suspended solids content of untreated effluent was 105 mg/l. [4] observed the TSS and sugar mill effluents is 220 to 790 mg/lit.

Chlorides are generally present in natural water. The presence of chloride in the natural water can be attributed to dissolution of salts deposits discharged of effluent from chemical industries, oil well operations sewage discharge of effluent from chemical industries, oil well operations sewage discharge, irrigation drainage sea water intrusion in coastal areas. In the present study chloride of untreated effluent was 1 mg/ l. Biological oxygen demand of dairy effluent showed 7.5 mg/l. Low value of BOD may be attributed to the quantity of total suspended solids in effluents as well as to the quantitative number of microbial populations [4]. The chemical oxygen demand of dairy effluent was found to be 244 mg/l. The bicarbonate content of dairy effluent showed0.80 m.e./l. The total hardness of water was noticed as 29 mg/l. Hardness is defined as the concentration of calcium & magnesium ions content of water [9]. The principal sources of hardness in water are run off from soil [14].

B. Growth parameters :

Germination percentage:

The germination percentage of Abelmoschus esculentus L. cultivar is found to be affected by different concentrations of the dairy effluent. It was found that maximum percentage of seed germination is seen at 80% concentration of dairy effluent. The minimum germination percentage was recorded in 100% concentration of dairy effluent. The reduction in the germination percentage was due to high amount of total dissolved solids that disturbed the osmotic relation and other metabolic constituent in the crop plants [12]. The same trend of results was observed in pharmaceutical effluent on green gram [7].

Table No. 2: Effect of various concentration of dairy effluent on growth parameters in Abelmoschus esculentus L

Group	Germination Percentage (%)	Root length(cm)	Shoot length (cm)	Fresh weight(g)	dry weight(g)
Control	60	6.3±2.73	5.5±1.56	0.948±0.04	0.73±0.02
20%	65	8.2±3.82	8.5±2.80	1.119±0.02	0.63±0.03
40%	70	9.4±2.02	8.7±1.26	1.078±0.03	0.78±0.01
60%	75	6.5±2.49	6±2.89	1.842±0.02	0.65±0.02
80%	73	7.5±1.56	8.3±2.42	1.708±0.01	0.70±0.03
100%	65	6.5±1.26	5.3±1.53	1.121±0.02	0.69±0.02

C. Root length and shoot length:

The root length and shoot length were measured on 5th day of germination and the results are shown in Table 2. The root length at 40% concentration of dairy effluent was increased when compared to that of control. The root length is found to be inhibited at the concentration of control, 20%, 60%, 80% and 100% of dairy effluent. Several workers have studied the effect of effluent of different industries on seed germination.[16] reported that the percentage of

germination was higher in 25 % surgical effluent than control in wheat, guar and radish but higher concentration of effluent affected germination percentage [2] observed the different effect of sugar industry effluent on seed germination of different plants. They found maximum seed germination of Solanum melongena in 5% effluent and of Lycopersicon esculentum in 100% effluent.

D. Fresh weight and dry weight:

Fresh weight and dry weight showed maximum at 60% concentration. The plants showed reduction in fresh weight with the increase in effluent concentration. Lower concentration of the effluent irrigated plants showed an increase in biomass content. Higher concentration above 60% showed lower biomass content than contro [11]. reported reduction in fresh weight of seedlings at higher concentration of the effluent. Similar results observed by [17].

E. Total chlorophyll content:

Chlorophyll estimation is one of the important biochemical parameters which is used as the index of production capacity. Total chlorophyll content was estimated at lower concentration (20%) and at higher concentration (100%). It is found that the total chlorophyll, chlorophyll a, chlorophyll b was increased at 40% concentration of dairy effluent when compared to the 100% dairy effluent. The inhibition is more at the highest concentration of dairy effluent. The dairy effluent may cause degradation of chlorophyll into their corresponding pheophytin. It is also inhibits chlorophyll biosynthesis. The reduction in chlorophyll content induced by higher concentration of effluent may be associated with mineral ions. It may also due to the formation of enzymes chlorophyllase which is responsible for chlorophyll degradation [3].

Table No. 3: Effect of various concentration of dairy effluent on chlorophyll a, b and total chlorophyll of Abelmoschus esculentus L.

Various concentration	Chlorophyll a	Chlorophyll b	Total chlorophyll
Control	0.078± 0.014	0.02 ± 0.008	0.10 ± 0.40
20%	0.23 ±0.004	0.32 ± 0.010	1.173 ± 0.018
40%	0.21±0.913	0.07 ± 0.019	1.8 ± 0.040
60%	0.03 ±0.004	0.071 ± 0.009	0.28± 0.002
80%	0.21 ±0.010	0.06 ± 0.012	0.29 ±0.003
100%	0.06 ±0.005	0.06 ± 0.011	0.07 ± 0.008

IV. CONCLUSION

In the present study, the effect of various concentrations of dairy effluent on early seedling growth of Abelmoschus esculentus L. was studied. The present study revealed that root length, shoot length, fresh weight and dry weight were found to be decreased at lower concentrations of dairy effluent (60%) but increase at higher concentration of dairy effluent. Total chlorophyll, chlorophyll a and chlorophyll b and total protein was increased at lower concentration of dairy effluent (40%) but decreased at higher concentrations (20, 60, 80 and 100%) of the effluent. The effluent application for plant is economical. The results confirmed that use of dairy effluent for agriculture purposes.

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