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EFFECT OF DAIRY EFFLUENT ON GROWTH AND BIOCHEMICAL CONSTITUENTS OF VIGNA RADIATA (L.) WILCZEK

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ABSTRACT

In the present study, the impact of 25%, 50%, and 75% effluent (as soil amendment) on the growth and some biochemical constituents of green gram plant *Vigna radiata* (L.). Wilczek. The present study showed that dairy industry effluent had an adverse effect on green gram at 50% dilution. But low dilution of the effluent (25 and 50%) was found suitable for plant growth. Thus proper dilution of dairy industry effluent could be safely utilized as irrigation water, a source of wealth from industrial waste.

KEYWARDS: Dairy Effluent, *Vigna radiata*, green gram, lipid, Protein, Dietary Fiber.

INTRODUCTION

The utilization of properly treated industrial effluent for irrigation of crop plants is one of the highly beneficial solution for prevention of pollution some effluents contain considerable amount of nutrients, which may prove beneficial for plant growth and it serves as an additional potential source of fertilizer for agricultural use.

Legumes are the cheaper sources of protein and hence their supply should be sustained to overcome malnutrition problem. Among the legumes, cluster bean [*Vigna radiata* (L.) R. Wilczek] is grown as a vegetable for human consumption, as a cover crop, green manure and as forage for cattle. Leaves are eaten to cure night-blindness. Green pods contain protein, fat, fiber, carbohydrate, cadmium, phosphorus, iron, vitamin A and vitamin C. Keeping these points in view, the present investigation was carried out to assess the efficacy of dairy effluent on the growth and some biochemical responses of mung bean. The biochemical parameters like total chlorophylls, total free amino acids and soluble protein content of leaves.

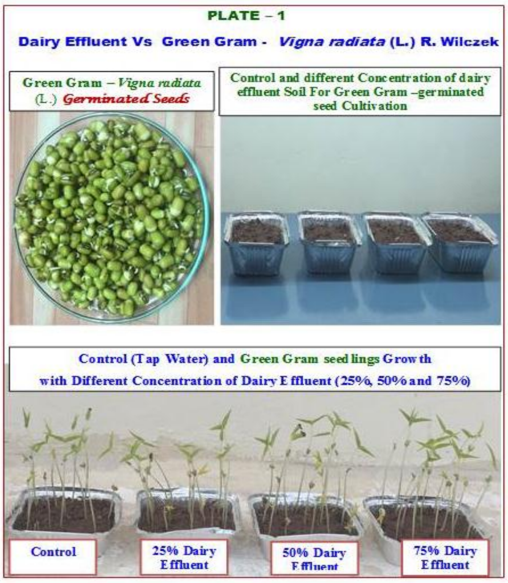
MATERIALS AND METHODS

Collection of dairy effluents: Four different types (purified effluent, starting material, chrome effluent and sodium-lime effluent) were collected from the outlet of industry in Dindigul, Tamil Nadu., in polythene bottles and stored in dark and room conditions for further uses.

The soil sample was collected from 2-3 Km away from effluent disposal point in pre cleaned, dried plastic buckets. Immediately the samples were stored at normal room temperature. The soil was dried, mixed thoroughly and sieved to eliminate debris.

Sampling

Seeds were sown in triplicates in plastic cups and filled with soil. The seeds were treated with equal volume of various concentrations of effluents (*viz*, 25, 50, and 75%) and distilled water left as control, left as such for 5th days for germination. The number of germinated seeds was counted on the 5th day itself (Plate-1). These seedlings were transferred to earthen pots.



Taken 4 earthen pots of uniform size were used to grow the plants. Pots were filled with garden soil. For the control one pot was kept and municipal tap water was used for irrigation. The remaining three were used as per the dilution (25%, 50%, and 75%) of dairy industry effluent (Plate 2).

25^{th} days after the commencement of dairy industry effluent treatment, the plants were harvested around 8.00 am for the measurement of growth, biomass and biochemical analysis. At each sampling five plants were plugged out, their roots were washed gently with deionized water and excess water was blotted out.

After measuring their shoot lengths, the fresh weight of three plants from the control and each treatment were kept in a hot air oven at 80°C for two days. After attaining the constant dry weight, the plant dry matter content (biomass) was determined. Leaf samples from the control and treated plants were collected for the analysis of total chlorophyll pigments, total free amino acids and soluble protein content.

Total Chlorophylls[1,2]

Fresh leaves weighing 0.5g were ground in a mortar with a pinch of calcium carbonate using acid washed sand and extracted with cold 80% acetone until the tissue became colourless. After filtration through Buckner's funnel with a Whatman No.41 filter paper, the extract was made upto a known volume with the same acetone.

The total chlorophyll content was estimated by measuring the absorbancy at 663 and 645 nm in the systronics spectrophotometer - 106, using the following formula and the results were expressed in mg g-1 fresh weight.

$$\text{Total chlorophyll} = \frac{(20.2A\ 645) + (80.2A\ 663) \times V}{W}$$

Where A = the absorbance at respective wave lengths.

V = the volume of the extract (ml) and

W = the fresh weight of the materials (mg).

Total Amino Acids[3]

4ml alcoholic extract from each sample were separately taken in beakers and allowed to evaporate on a sand bath. To the residue, 4ml distilled water was added and this aqueous extract was taken in a test tube. To each test tube, 0.5ml of the buffer and 1ml of ninhydrin solution were added and the reaction mixture was heated for 15minutes in a water bath at 100˚C for colour development. The colour intensity was measured in a systronics spectrophotometer (106) at 610nm against a reagent blank. The amount of free amino acids was expressed as mg glycine equivalents g-1 fresh weight.

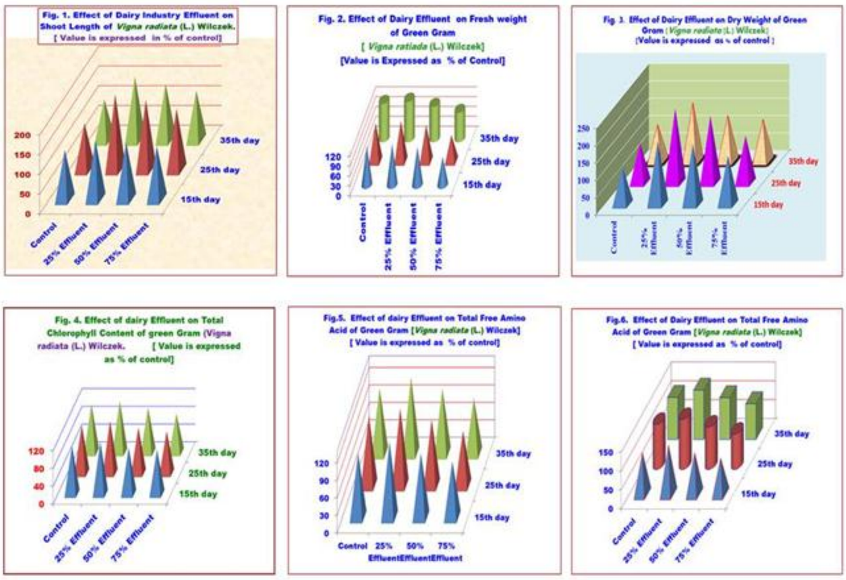
Soluble Protein[4]

1ml of protein solution was diluted to 10ml with distilled water. To 1ml of protein solution, 5ml alkaline copper solution was added, shaken well and allowed to stand at room temperature for 10minutes. 0.5ml of folin ciocalteau reagent was rapidly added with mixing. After 30minutes of standing, optical density was read at 660nm with systonics spectrophotometer – 106. Protein was calculated by referring to a standard curve of BSA. Results were expressed as mg protein g-1 fresh weight.

RESULTS AND DISCUSSION

Plant Growth

Total nitrogen, phosphate, potassium, sulphate, chloride, calcium and magnesium in the effluent might cause injury to plant growth by reducing water absorption and affecting metabolic processes in the plant.[5,6] Medhi *et al.*,[7] attributed the gradual decline in the seedling growth with increasing concentration of dairy industry effluent due to the higher amount of dissolved solids present in the total dissolved solids.



The increase in growth parameters in low concentration of dairy effluent might be due to the reduction in the level of toxic metabolites by dilution and better utilization of inorganic nutrients like NPK and other minerals present in the effluent.[7] Madan and Pertibha[8] attributed the decreased growth parameters at higher concentration of industry effluent to the decrease in the enzyme dehydrogenase activity.

The root length and shoot length were maximum in 25% concentration (10.593 cm) and (14.120 cm) respectively and minimum in 75% concentration (1.5.473 cm) and (1.700 cm) respectively. There was not much difference in root length of control (8.433 cm) and 50% concentration (8.416 cm). The root and shoot length decreased significantly as the concentration of effluent increased from 25% to 50% concentration and decreased in 75%. Similar results were shown by Selvi *et al.*[9] for tannery effluent exposure.

Effect of dairy effluent on the shoot length of green gram is depicted in Fig 1. When compared with control, 25% effluent enhanced shoots length in all the three sampling periods (i.e. 15, 25 and 35days after treatment). Nearly 5 to 8% enhanced shoot length was observed in the 25% effluent treated plant. In the 50%, and 75% effluent, the shoot length was gradually towards the higher concentration than the control. Nearly 2 to 6% reduction was observed.

Enhanced shoot length with low concentration and inhibition in higher concentration of dairy effluent was in accordance with the earlier work of Rajannan and Oblisami[5] in rice, black gram and tomato. Dutta and Boishya[6] in paddy; Joshi and Tardon[10] in *Vigna radiata*, *Gylcine max* and *Cicer aeritinum*; Malla and Mohandy[11] in green gram; Medhi *et al.*,[7] in mustard, pea and rice; Kalaichelvi and Rajeswari[12] in *Vigna mungo* and Madan and Pertitibha[8] in *Cicer aeritinum*.

Biomass Content

In the present study fresh weight was found to be higher at 25% and decreased as the effluent concentration increased. Selvi and Sharavanan[13] also reported similar results that higher concentration of dairy effluent decreased the fresh weight of *Phaseolus tribolus* seedlings. Varma and Sharma[14] also reported similar results in *Abelomoschus esculentus* and *Cymopsis tetragonoloba* with Amul dairy effluent.

Impact of dairy effluent on the fresh and dry weight of green gram is given in Figs. 2 & 3. When compared with control, nearly 9 to 15% enhancement of fresh weigh and 10 to 12% enhancement of dry weight were observed in 50% effluent treated plants(Fig. 2 & 3).

Whereas at 75% effluent concentration, reduction in the fresh weight and dry weight were observed. Nearly 7 to 12% reduction in the fresh weight and dry weight were recorded.

Enhancement of fresh and dry biomass content with low concentration of dairy mill effluent were in accordance with the earlier report of Kalaichelvi and Rajeswari[12] in *Vigna mungo* and Petal *et al*.[15] in cabbage, wheat, groundnut and green gram. Madan and Pertibha[8] reported maximum biomass in *Cicer aeritinum* with 50% dairy effluent. Enhanced biomass may be due to the enhanced photosynthetic activity. This is evidenced from the higher content of total chlorophyll in the 50% effluent treated green gram.

Chlorophyll Content

Impact of dairy effluent on the total chlorophyll content of cluster bean is depicted in Fig- 4. When compared with control, nearly 22 to 30% enhanced total chlorophyll content was observed in 50% effluent treated plant, But in the 75% effluent treated plant, nearly 1 to 3% reduction in the total chlorophyll content was recorded.

Enhanced chlorophyll content with low concentration of dairy industry effluent was in accordance with the earlier work of Singhal *et al*.,[16] in *Vallisneria spiralis*; Kalaichelvi and Rajeswari[12] in *Vigna mungo* and Madan and Pertibha[8] in *Cicer aeritinum*. Increasing trend of chlorophyll content at lower concentration may be due to the favourable effect of optimum level of nutrients required for biosynthesis of chlorophyll pigments as suggested by Kalaichelvi and Rajeswari.[12]

Amino acids content

Effect of dairy industry effluent on the total free amino acids content of cluster bean is presented in Fig.5. When compared with control, 50% effluent treated plants revealed 10 to 20% increase in the amino acids content (Fig.5). But nearly 11 to 14% reduction in the total free amino acids content was recorded in 75% effluent treated plant. Selvarathi and Ramasubramanian[17] reported that application of treated dairy industry effluent decreased the amino acids content of *Lycopersion esculentum.*

Protein Content

Effect of dairy industry effluent on the total soluble protein content of cluster bean is depicted in Fig. 6. When compared with control, 10 to 14% increase in the protein content was recorded in the 25% effluent treated plant (Fig. 6). But at 50% effluent concentration, nearly

4 to 5% increase in the protein content was recorded. Enhanced protein content with diluted dairy industry effluent was in accordance with the earlier work of Rout[18] in *Phaseolus aureus*, Mishra and Behera[19] in rice and Kalaichelvi and Rajeswari[12] in *Vigna mungo*. Increased protein content was reported by Selvarathi and Ramasubramanian[17] in *Lycopersicon esculentum* grown in phyto-treated dairy industry effluent application.

SUMMARY AND CONCLUSION

Samples from the control and treated plants were used for the analysis of total chlorophyll, total free amino acids and soluble protein content of green gram plant *Viigna radiata* (L.). Wilczek. When compared with untreated control, shoot length of 25% and 50% dairy industry effluent treated green gram plants was enhanced. At 75% concentration, the shoot length was slightly inhibited. Fresh and dry biomass content of plants was higher in the 25% and 50% dairy industry effluent treated plants than the control. 75% effluent treatment decreases the biomass content. Total chlorophyll content was enhanced in 50% dairy industry effluent treated plants, whereas, the reduction in the pigment content was observed in the 75% and 100% effluent treatment. 50% dairy industry effluent treated plants showed higher total free amino acids and total soluble protein content. But 75% effluent treatment showed lower content of amino acids and protein than 25% and 75% of diluted dairy effluent.

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