

Effect of Textile Waste Water Irrigation on Seed Germination, Plant Growth, Biomass, and Crop Yield in Green Gram Seeds (*Vigna radiate*(L)Wilczesz) Under Plating Technique and Pot Experiment

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Abstract: In the present study green gram (*Vigna radiate* (L) Wilczesz) was cultivated in plate and pot method using decolorized textile effluent (dye waste water) at different concentration 25%, 50%, 100% beside a control. Regular observation was made on growth and yield of the plants. The noted seed germination was well grown in all the concentrations. The plant survival rate was well in all the dye waste water concentration. Root shoot ratio under different treatment was found in the order of 100>50>25>0. The chlorophyll a, b and protein content in the leaves (mg g⁻¹) was found to be higher 100% followed by 50%, 25% and control.

Keywords: Textile waste water, Seed germination, Plant growth, Green gram seed.

I. Introduction

Large amount of waste water 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 [1,2,3]. In India, only 30% of the Waste water is treated before it is being discharged in to the environment. In most cases, the industries untreated effluent water directly finds its way into water systems like river, lakes, ground water and coastal waters causing serious water pollution [4]. In general, plants are much more resistant to an increased concentration than an insufficient content of a given element. Reports of research work are available on the use of industrial effluents, namely dyeing factory effluents in seed germination and seedling development of groundnut [5], paper factory effluent in germination of crop seeds of rice, black gram and tomato [6], Protein industry effluent in the cultivation of rice crop [8] and Viscose factory effluent in groundnut plant growth [7]. The excess content of sodium alkalinity combined with salinity in industrial effluents was found to be deleterious to crops unless they were properly diluted and effluents containing zinc, cadmium, copper, nickel and lead resulted in phytotoxicity [9]. In the present study, Textile dye waste water was decolorized using nanoparticles. Green gram Seed germination, Plant growth, Biomass and Biochemical content was analyzed in different decolorized water concentration.

II. Materials And Methods

Seed Germination under Plating Techniques

The green gram seeds were collected from Ammangudi village in Thottiyam Talk, Trichy district, Tamil nadu. Seeds were surface sterilized by sodium hypochlorite solution (1% active chlorine) for 10 minutes to avoid fungal contamination before plating. Totally 80 seeds were tested for each concentration (0 %, 25%, 50%, 100%) of the treated textile water. Each Petri disk received 20 surface sterilized seeds and 8cc of treated textile water was added on Petri disk in desired concentration. The temperature during the period was kept at 26± 1°C. The growth parameters including weight, shoot length and seed vigor (cm), germination percentage was recorded one week after planting.

Plant Growth under Pot Experiment

The pot experiment was conducted in polytunnel green house, Department of Plant Science, Bharathidasan University, Tiruchirappalli, Tamil nadu, India. The four pots measuring 17cm height, 18 cm width and 5 cm depth were taken. The pot were filled with equal amount of (1:1:1) clay, soil and sand. Then seeds were sown in 1cm deep. After emergence, seeding was thinned to 10 plants per pot. Different

concentration 0%, 25%, 50%, 100% of decolorized waste water was used in each pot. After irrigation event, enough water was allowed to be absorbed by the soil in each pot and any excess water was allowed to drain. Growth stage (7-29) days and flowering stage (30-35) days. Plants were harvested at 60th day and observations were recorded for various morphological and yield parameters.

Growth Parameter

The shoot, leaf, and root length of random seedling of 60 day old green gram plant from each concentration was measured.

Estimation of Chlorophyll

Chlorophyll was estimated using protocol of Holden method [10]. The leaves were weighed 100 mg and cut into small pieces. Then it was homogenized with 80% acetone and CaCO₃ was added to prevent pheophytin formation. Then the homogenized materials were centrifuged at 5000rpm for 10 minutes at room temperature. The supernatant was collected and then made up to 10ml with distilled water. The test tube wrapped with black paper to protect chlorophyll degradation. The colorimeter was adjusted at wave length of 663nm for chlorophyll 'a,' and 645 nm for chlorophyll 'b' set at 100% transmittance using 80% acetone as blank before taking the readings of the samples. Optical density was measured and the chlorophyll content in the original extract was estimated using the following calculations [11]

$$\text{Chlorophyll content a} = \text{Absorbance } 663\text{nm} * (0.058) - (\text{Absorbance } 645\text{nm}) * 0.032)$$

$$\text{Chlorophyll content b} = \text{Absorbance } 645\text{nm} * (0.096) - (\text{Absorbance } 663\text{nm} * 0.01872)$$

$$\text{Total chlorophyll content} = (\text{Absorbance } 645\text{nm} * 20.2) + (\text{Absorbance } 663\text{nm} * 8.3) * (V/100 * W)$$

Where W= Dry weight of plant material

V= Final volume of chlorophyll extraction in 80% acetone

Protein Estimation

Total protein estimation was performed by Lowry method [12], plant leaves were weighed 5g and grinded well with 10 ml of distilled water in mortar and pestle. After vortex for 2 minutes, tubes were centrifuged for 10 minutes at 5000rpm. Supernatant was taken and made up the volume to 1 ml with distilled water and 3ml of reagent (50 ml of reagent A (2% sodium carbonate in 0.1 N sodium hydroxide) and 1ml of reagent B (0.5 % copper sulfate in 1% potassium sodium tartar ate)) were added. After adding 0.2 ml of Folin ciocalteu reagent tube was incubated for 30 minutes at room temperature. Bovine serum albumin was used as standard in a range of 20 – 100 mg/ml. All the samples and standards were prepared in triplicates and absorbance was measured at 750nm.

Statistical Analysis

Mean values of three measurements with standard deviation (SD) were taken. Data were statistically analyzed by analysis of variance (ANOVA). Means were separated using Duncan's multiple range test at p≤ 0.05 level of significance using SPSS software (Version 16).

III. Results And Discussion

Experiment 1

Seed Germination Percentage

Table 1 showed the seed germination in terms of shoot & root length, seedling weight and seed vigor of the waste water treatment concentration (0%, 25%, 50%, 100%). In the present study, no mortality was observed in all the treatment. All the treatment Seeds were exhibited a successful germination. It showed that the textile dye waste water was not affecting the seed germination.

Shoot and Root Length

As shown in Table 1 shoot length and root length were higher in 100 % treatment when compared to other concentration. Shoot and root length were significantly (p<0.05) increased compared to control. In the present study, textile treated waste water has no negative effect on the plant cultivate of green gram seeds and also has the ability to increase Shoot and root length at different waste water concentration.

Seedling Weight and Seed Vigor

All the waste water concentration treatment seedling weight and seed vigor were exhibited a better growth compared to control (Tab. 1). Seedling weight and Seed vigor were significantly increased (p<0.05).

Table 1 Effect of Textile Waste Water Different Concentration on Green Gram Seed Germination Traits

Treatment	Seed germination	Shoot length(cm)	Root length(cm)	Seedling weight(mg)	Vigor%(cm)
0%(con)	100	9.4±.35 ^{bc}	6.0±40 ^{bc}	9.60±44 ^c	20.53±.77 ^c
25%	100	9.4±.55 ^{bc}	6.6±.55 ^b	15.7±.75 ^b	21.9±1.8 ^c
50%	100	9.9±50 ^b	6.6±.55 ^b	18.9±.75a	30.73±1.2 ^b
100%	100	13.6±.60 ^a	9.4±.40 ^a	19.2±.23 ^a	39.1±13 ^a

All values are ±SD. Mean in columns of same parameter followed by same letters are not significantly different (p<0.05).

Table 2 Effects Of Different Irrigation Treatments on Morphological Parameters of Green Gram Plant

Treatment	Plant height	Leaf no.of per plant	Leaf area cm ² /plant	Stem weight	Leaf weight	Leaf to stem ratio	Total biomass	No of Flower	No of seeds
0%(con)	17.79 ^b ±3.15	4.36 ^a ±3.00	40.36 ^a ±12.9	0.87 ^c ±12.9	0.94 ^b ±0.15	0.83 ^c ±0.02	1.50 ^b ±0.10	9.0 ^a ±1.0	0.6 ^b ±1.0
25%	21.6 ^{ab} ±4.93	6.76 ^b ±0.32	44.5 ^a ±2.37	0.99 ^{ab} ±0.01	1.09 ^b ±0.08	0.83 ^{ab} ±0.11	2.13 ^a ±0.05	1.2 ^b ±1.0	0.7 ^b ±1.5
50%	23.9 ^{ab} ±2.91	7.13 ^a ±0.25	50.82 ^a ±11.8	1.165 ^a ±0.02	1.15 ^{ab} ±0.0p5	0.94 ^{ab} ±0.05	2.4 ^a ±0.1	1.3 ^{ab} ±1.52	1.0a±1.5
100%	27.56 ^a ±3.73	7.9 ^a ±0.17	63.57 ^a ±25.25	1.43 ^a ±0.03	1.36 ^a ±0.15	1 ^a ±0.02	2.5 ^a ±0.4	1.5 ^a ±1.0	1.1a±1.0

All values are ±SD. Mean in columns of same parameter followed by same letters are not significantly different (p<0.05).

Table 2 shows ANOVA performed on the results for each wastewater treatment concentration separately. Significantly increases were seen in survival rate of plants under 25%, 50%, 100% irrigation water and control. After transplantation, the survival percentage for green gram was found to be Maximum in 100%, followed by 50%, and 25%. Cultivate was better in 100% and 50% as compared to control possibly due to more availability of nutrients. Height (Shoot length) was in the order of 100>50>25% (p≤0.05) (Table 2). Overall, the nutrient availability in 100% has positive influence on the plant survival, height, number of seeds and leaf area on green gram plants. Root and shoot length ratio was significantly more in 100% at p<0.05 and varied in the pattern 50%>25% indicating that the root length was increased under nutrient conditions (Table 2).similar results have been reported by [13,4] waste water supplies nutrients and enhances leaf area and biomass. Maximum numbers of Seeds (Table 2) were obtained in 100% (10/plant). Plants received 100% and 50% had more total dry biomass than control but the 25% concentration showed minimum biomass.

Table 3 Effects of Different Irrigation Treatments on Biochemical Content of Green Gram Plant

Water concentration	Chlorophyll a	Chlorophyll b	Total Chlorophyll (mg/ml)	Total Protein (mg/ml)
0% (Con)	0.012	0.037	13.71	17.45
25%	0.011	0.040	14.42	18.12
50%	0.019	0.047	18.3	18.18
100%	0.02	0.04	19.4	18.96

The leaf area was maximum in 100% and 50% and minimum in 25% giving more area for photo synthetic activity (Table 3). The chlorophyll (total, a,b) and protein content observed in the leaves, varied in the order 100%>50%>25% and 0%(con). Chlorophyll content was enhanced in 100% and 50% which may be due to higher availability of magnesium [14].

IV. Conclusion

Green gram was able to meet its nutrient requirements from decolorized water and established good growth showing no signs of toxicity at any stages of seed germination and growth. The decolorized water consist suitable organic matter and nutrient contents in soil enhancing the growth of plant.

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