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Original Research Paper

Effects of Protein Industry Effluent on the Seed Germination, Seedling Growth and Photosynthetic Pigment of Blackgram (*Vigna mungo* L. Var. 9)

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ABSTRACT

The effect of different concentrations of protein industry effluent on seed germination, seedling growth and pigment content of blackgram has been studied in the laboratory conditions. The germination percentage, seedling growth, fresh weight and dry weight of seedlings, and photosynthetic pigments such as chlorophyll and carotenoid were found to be retarded with increase of effluent concentration. However, the effluent at lower concentration of 5% promoted these growth parameters. No germination was recorded at 75 and 100 percent effluent.

INTRODUCTION

Industrial effluents, a major source of pollution, contain a number of organic and inorganic pollutants that are toxic to aquatic environment. The disposal of industrial effluents into nearby water bodies cause serious water pollution problems in India. The polluted water has greatly affected the agricultural production when used for irrigation. The effects of various industrial effluents such as from protein industry **(**Rajannan & Kandasamy 1990), dying industry (Swaminathan & Vaideeswaran 1991), tannery (Singaram 1995), fertilizer factory (Subramani et al. 1998), plywood industry (Ghosh & Kumar 2000), and distillery (Samyuktha et al. 2005) have been worked out on seed germination and growth of plants. This paper deals with the effect of protein industry effluent on germination, growth and pigment contents of blackgram (*Vigna mungo* L.)

MATERIALS AND METHODS

The effluent samples were collected in plastic container from the outlet of the protein industry, Pondicherry. The physicochemical properties of effluent were determined by following standard methods (APHA 1992).

The seeds of blackgram *(Vigna mungo* L. Var. 9) were obtained from PASIC, Pondicherry. Healthy seeds were selected and sterilized with 0.2% mercuric chloride for about two minutes to prevent from the surface contamination. The seeds were washed under running tap water for 30 min. Thirty seeds of blackgram were kept at equal space in sterilized Petri plates lined with filter paper. The Petri plates were moistened by periodical addition of a known volume of respective concentration (5, 10, 25, 50, 75, and 100 per cent) of the protein industry effluent. Seeds treated with distilled water served as control. The number of seeds germinated were counted and recorded daily and allowed to grow well. The protrusion of radicle through seed coat was taken as criterion for germination. On the 8th day, seedling growth was measured and recorded. The fresh weights of seedlings were measured by using an electrical single pan balance. The dry weight of blackgram seedlings was taken after drying them in a hot air oven. Photosynthetic pigments of blackgram seedlings were estimated by the following Arnon's method (Arnon 1949). The vigour index (Abdul Bagi & Anderson 1975) and percentage of phytotoxicity (Chou et al. 1978) was also calculated.

RESULTS AND DISCUSSION

The physicochemical properties of protein industry effluent are presented in Table 1. The effluent is acidic (pH 6.1) in nature and light yellow in colour with pungent small. The total suspended solids (TSS) and chemical oxygen demand (COD) were much higher than the recommended standards for the discharge of industrial effluents on land for irrigation.

The effect of different concentrations of protein industry effluent on seed germination and growth parameters of blackgram are given in Table 2. The germination of blackgram seeds gradually decreased with increase of effluent concentration, and got inhibited significantly at the level of 50% concentration of the effluent. Reduction in germination of seeds with increasing pollution is known to occur in different plants (Chaphekar 1991).

The Germination was more at lower concentration of 5% than that of control. The Vigour Index of seedlings was significantly low in undiluted effluent when compared to control. It increased with the decrease in the concentrations of effluent. The lower concentration of 5 % effluent has a marked promoting effect on overall growth and weight of blackgram seedlings. The increase in germination percentage and seedling growth at lower concentration may be due to presence of good amount of nutrients present in the effluent. However, the excess minerals and nutrients inhibit the germination and growth by interfering with metabolic activities during germination and growth (Verma & Verma 1995). Reduction in germination and seedling growth due to effluent treatment also associated with reduction of chlorophyll pigments and carotenoids (Manonmani et al. 1992). The pronounced inhibition of shoot and root length were the main cause for the decrease in fresh weight and dry weight of seedlings (Mariappan et al. 2001). Srivastava (1991) reported similar results in *Raphanus sativa* seeds treated with paper mill effluent.

The changes in photosynthetic pigments like chlorophyll *a*, Chlorophyll *b* and total chlorophyll, and carotenoid content of blackgram seedlings due to effluent treatment are given in Table 3. The photosynthetic pigments of blackgram seedlings also exhibited an increase at 5% concentration, with progressive decline at higher concentrations. It seems that the lower concentration (5%) of the

Table 1: Physicochemical analysis of protein industry effluent.

Parameters	Effluent analysis data
Colour	Light yellow
Odour	Pungent smell
pH	6.1
Temperature	29°C
Acidity	540
Total suspended soils	190
Total dissolved solids	5100
Biochemical oxygen demand	550
Chemical oxygen demand	1450
Nitrogen	4.76

All the parameters are expressed in mg/L except colour, odour, temperature and pH.

Table 2: Effect of protein industry effluent on seed germination percentage, seedling growth, fresh weight and dry weight of blackgram (*Vigna mungo*) seedlings.

Effluent Concentrations	Germination Percentage	Seedling length (cm/seedling)	Fresh weight of seedling (g/seedling)	Dry weight of seedling (g/seedling)	Vigour Index	Percentage of Phytotoxicity
Control	74 ± 3.70	15.6 ± 1.593	1.013 ± 0.05	0.523 ± 0.02	1154.4 ± 57.72	
5 %	80 ± 4.00	16.6 ± 1.2267	1.375 ± 0.06	0.615 ± 0.03	1328.0 ± 66.4	101.14 ± 3.034
10 %	57 ± 2.85	14.0 ± 0.712	0.950 ± 0.04	0.506 ± 0.02	798.0 ± 39.9	83.26 ± 4.163
25 %	42 ± 2.10	10.5 ± 0.712	0.632 ± 0.03	0.308 ± 0.01	441.0 ± 22.05	62.10 ± 2.484
50 %	28 ± 1.40	5.1 ± 0.6066	0.547 ± 0.02	0.242 ± 0.01	142.8 ± 7.1	27.59 ± 1.099

No germination was observed beyond 50% effluent content; ± Standard deviation

Table 3: Effect of protein industry effluent on Chlorophyll *a*, Chlorophyll *b*, total Chlorophyll and carotenoid contents of blackgram (*Vigna mungo*) seedlings.

Effluent concentrations in	Photosynthetic pigments (mg/g fr. wt.)			
	Chlorophyll *a*	Chlorophyll *b*	Total chlorophyll	Carotenoids
Control	0.3181 ± 0.01	0.3988 ± 0.01	0.7169 ± 0.03	0.4112 ± 0.02
5 %	0.4625 ± 0.02	0.4825 ± 0.02	0.9450 ± 0.04	0.5625 ± 0.02
10 %	0.3637 ± 0.01	0.4323 ± 0.02	0.7869 ± 0.03	0.4552 ± 0.02
25 %	0.2778 ± 0.01	0.2905 ± 0.01	0.5683 ± 0.02	0.3140 ± 0.01
50 %	0.1825 ± 0.009	0.1972 ± 0.009	0.2172 ± 0.01	0.2172 ± 0.01

No germination was observed beyond 50 % Concentration; ± Standard deviation

effluent is optimum level of dilution, which significantly favours the chlorophyll biosynthesis in seedlings. This is in accordance with the observations of Srivastava (1991), Swaminathan & Vaidtheeswaran (1991) and Subranabi et al. (1998). The effluent exhibited adverse effects on photosynthetic pigments at higher concentration (50%). The inhibitory effect of higher concentration may be due to high BOD, and suspended and soluble solids. The reduction in chlorophyll content at higher concentration may also be due to high salinity induced by excessive soluble slats in the effluent (Dutta & Boissya 1999).

The findings of the present work revealed that the untreated protein industry effluent has negative effect on germination of seeds. Therefore, the effluent should be treated and diluted so that it can be used as a potential source of liquid fertilizer for agricultural crops. This kind of approach helps to prevent the environmental pollution hazards to some extent.

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