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RESEARCH ARTICLE

Evaluation of the irrigation potential of variously treated (biological, chemical and reverse osmosis) dye factory effluents on growth and yield of black gram [*Vigna mungo* (L.) Hepper.] under pot condition

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SUMMARY

Studies on the effect of the irrigation potential of variously treated (biological, chemical and reverse osmosis) dye factory effluents on growth and yield of black gram were evaluated under pot condition. The physico-chemical parameters of RO treated effluent were well within the ISI tolerance limits. The plant growth as measured by shoot length, root length and plant biomass was maximum in all growth stages of black gram when irrigated with RO treated effluent. In the same treatment black gram recorded maximum yield in terms of pod length, number of seeds per pod, number of pods per plant, grain yield per plant and 1000 seeds weight.

Key Words : *Vigna mungo*, Dye factory effluent, Variously treated [biological, chemical and reverse osmosis (RO)]

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Increasing pace of industrialization in public and private sectors along with population explosion, urbanization and green revolution are reflected in varying degrees of the purity of the water, soil and air. A majority of industries are water based and a considerable volume of waste waters are discharged to the environment either untreated or inadequately treated leading to the problem of surface and ground water pollution. According to Romanini (2007) the effect of global warming is one of the factors that have reignited discussions on sustainability by altering society of the need for companies to adopt proper attitudes towards the environment. Even after having various measures to control the pollution, the problem still exist in various industries like textiles, tanning, paper products, cement etc.

The reuse of industrial effluents for irrigation has become wide spread in the state of Tamil Nadu after a High Court order in the early 1990s, within 1 km from the embankments of a list of rivers, streams, reservoirs etc. (Appasamy and Nalliyat, 2000). The disposal of industrial effluents on land for irrigation is a comparatively new area of research and hence, throws new challenges for environmental and agricultural management (Narwal *et al.*, 2006; Garg and Kaushik, 2006). From the agricultural point of view treated waste water could be used effectively provided certain quality constraints are met. In the present investigation an attempt has been made to evaluate both the beneficial and adverse effects of using variously treated (biological, chemical and RO) dye factory effluents on black gram.

MATERIAL AND METHODS

In the present study the variously treated (biological,

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chemical and reverse osmosis) effluents collected from a medium sized dyeing factory, SIPCOT, Perundurai, Erode District, Tamil Nadu, India were used as irrigation water.

The colour of the effluent samples were recorded by visual observation. pH of the effluent samples were determined using a standard Elico pH meter. By following standard methods of Anonymous (1972) and Sundaresan (1979) BOD and COD of the effluent samples were analysed, respectively.

Black gram [*Vigna mungo* (L.) Hepper Var. TMV 1] seeds procured from Tamil Nadu Agricultural University, Coimbatore were surface sterilized with 0.1% $HgCl_2$ solution and sown at the rate of 5 seeds per pot (30 x 20 cm) and watered at fortnightly interval with the variously treated effluents.

From the periphery of each pot, one plant was uprooted each time along with their entire root system on 20, 40, 60 and 80th days after sowing for the measurement of shoot length, root length and biomass.

Plant yield was expressed as the mean pod length, number of grains / pod, weight of 1000 grains, number of pods / plant and grain yield per plant.

Well water was used for intermittent watering whenever necessary. No fertilizer / pesticide were applied to the plants during the course of the study.

RESULTS AND DISCUSSION

Table 1 reveals the physico-chemical characteristics of variously treated dye factory effluents. Colour, pH, EC,

Table 1 : Physico-chemical characteristics* of variously treated (biological, chemical and RO) dye factory effluents

Sr. No.	Parameters	Effluent samples			** ISI tolerance limit
		Biologically treated	Chemically treated	RO treated	
1.	Colour	Dark brown	Dark brown	Pale white	Colourless
2.	pH	8.52 ± 0.372	7.5 ± 0.265	6.5 ± 0.218	6.73
3.	EC (dSm^{-1})	1.3 ± 0.140	1.2 ± 0.165	0.62 ± 0.124	-
4.	BOD ($mg\ l^{-1}$)	12 ± 0.23	9 ± 0.17	BDL	350
5.	COD ($mg\ l^{-1}$)	125.00 ± 3.23	116 ± 2.58	BDL	250 Max

* Each value is mean ± SE of three individual observations,
**Tolerance limits for individual effluents discharged on land for irrigational purpose IS:3307:1965

Table 2 : Effect of variously treated (biological, chemical and RO) dye factory effluents on the growth characteristics of *Vigna mungo* at different growth stages under pot condition

Sr. No.	Parameters	Effluent samples	Plant age (days)			
			20	40	60	80
1	Shoot length (cm)	Control	16 ± 1.16^{c}	38 ± 1.54^{a}	40 ± 1.25^{b}	45 ± 1.14^{a}
		Biologically treated	15 ± 1.20^{bc}	35 ± 1.16^{bc}	38 ± 1.98^{c}	39 ± 2.24^{b}
		Chemically treated	15 ± 1.40^{bc}	40 ± 1.29^{a}	42 ± 1.68^{ab}	46 ± 1.38^{a}
		RO treated	19 ± 1.29^{a}	40 ± 1.17^{a}	44 ± 1.55^{a}	46 ± 1.28^{a}
2	Root length (cm)	Control	12 ± 1.23^{a}	24 ± 2.34^{b}	28 ± 1.25^{b}	30 ± 1.62^{bc}
		Biologically treated	12 ± 1.56^{a}	20 ± 1.48^{c}	25 ± 1.95^{c}	26 ± 1.47^{d}
		Chemically treated	12 ± 1.02^{a}	25 ± 1.46^{ab}	29 ± 1.52^{ab}	31 ± 1.35^{b}
		RO treated	13 ± 1.28^{a}	26 ± 1.55^{a}	30 ± 1.58^{a}	35 ± 1.14^{a}
3	Biomass (g/plant)	Control	0.24 ± 0.02^{b}	0.82 ± 0.16^{a}	1.98 ± 0.17^{c}	2.92 ± 0.25^{a}
		Biologically treated	0.19 ± 0.03^{c}	0.68 ± 0.09^{b}	1.80 ± 0.18^{c}	2.44 ± 0.19^{b}
		Chemically treated	0.21 ± 0.02^{b}	0.79 ± 0.06^{a}	2.36 ± 0.13^{b}	2.94 ± 0.21^{a}
		RO treated	0.33 ± 0.04^{a}	0.93 ± 0.12^{a}	2.79 ± 0.12^{a}	3.14 ± 0.30^{a}

*Based on five determinations for each treatment, Values with same superscript in each sampling day in the columns do not differ significantly from each other (P<0.05), Stastical analysis of data is DMRT – Duncan's multiple range test

Table 3 : Impact of raw, variously treated (biological, chemical and RO) dye factory effluents on the yield characteristics of *Vigna mungo* under pot condition

Sr. No.	Parameters	Control	Effluent samples		
			Biologically treated	Chemically treated	RO treated
1.	Pod length (cm)	4.0 ± 0.39^{c}	4.5 ± 0.39^{c}	5.0 ± 0.42^{b}	5.6 ± 0.31^{a}
2.	Number of pods/plant	42.0 ± 0.68^{b}	37.0 ± 0.88^{e}	41.0 ± 1.03^{c}	44.0 ± 1.17^{a}
3.	Number of seeds/pod	6.0 ± 0.48^{b}	6.0 ± 0.74^{b}	6.0 ± 0.21^{b}	7.0 ± 0.60^{a}
4.	Grain yield/plant(g)	19.5 ± 0.47^{b}	18.1 ± 0.56^{c}	18.8 ± 0.68^{c}	20.6 ± 0.87^{a}
5.	1000 Seeds weight (g)	34.9 ± 1.14^{a}	33.2 ± 0.39^{b}	34.1± 1.08^{a}	35.3 ± 1.07^{a}

*Based on five determinations for each treatment, Values with same superscript in each samples in the row do not differ significantly from each other (P<0.05), Stastical analysis of data is DMRT – Duncan's multiple range test

BOD and COD were gradually reduced in biologically treated, chemically treated and RO treated effluents. The content of nitrogen, phosphorus, potassium, sodium and sulphate were well within the ISI tolerance limits. The same trend was observed by other workers (Saravanamoorthy and Ranjitha Kumari, 2007; Garg and Kaushik, 2008; Wins and Murugan, 2010).

Table 2 reveals the effect of variously treated dye factory effluent on shoot length, root length and biomass of black gram at different growth stages. Highest growth was observed in the plants irrigated with RO treated effluent at all growth stages studied.

Maximum growth of plants in treated effluent irrigation may be attributed to reduction in concentration of constituents to beneficial level (Sahai *et al.,* 1983; Wins and Murugan, 2010) and enhanced plant nutrients such as N and K present in the effluent (Mishra, 1987; Rehman *et al.*, 2008).The presence of root promoting phenolic compounds in the dyes (Augusthy and Sherin, 2001) might have played a role in growth promotion.

The impact of variously treated effluents on the yield of black gram is shown in Table 3. The yield parameters such as number of pods, number of seeds per pod and 1000 seeds weight registered significant increases in RO treated effluent treatment. Similar trend was noticed by Yadav and Meenakshi (2007); Saravanamoorthy and Ranjitha Kumari (2007); Sharmila *et al.* (2010) and Jayashree *et al.* (2010).

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