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IRRIGATIONAI IMPACT OF DYE HOUSE EFFLUENT ON GROWTH AND SOIL CHARACTERISTICS

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ABSTRACT

INTRODUCTION

Disposal of industrial effluents in agricultural land Is becoming a wide spread practice (Rajannan and Obiisami, 1979, Juwarkar and Subrahmanyam, 1987) These effluents not only contain nutrients that enhance the growth of crop plants but also have toxic material. Therefore, it is essential that the implications of the industrial effluents on the crop yield and soil characteristics are thoroughly investigated before they are recommended for use in irrigation.

MATERIAL AND METHOD

The effluent samples were collected from a medium size dye house effluent The physico-chemical properties of the effluent were estimated by ISI (1974, 1977) taierance limit. Healthy seeds of *Vigna radiata (L) R. Witczek* were used for test plant on petridishes and earthern pots. The Earthern pots filled with field soil were drenched with different concentrations (25, 50, 75, 100 and treated) of effluent. Healthy seeds were sown and watered at fortnightly interval. The results were observed at four age levels (20, 40, 60 and 80 - old - days). For chemical analysis of soil samples were analysed on the day 0 and on 80^{th} day after harvest. The biochemical constituents such as chlorophyll (Arnon, 1949), Protein (Lowry *et al,* 1951), and carbohydrates (Clegg, 1956) were studied.

RESULTS AND DISCUSSION

Analysis of the different parameters of the raw and treated effluents of the dye house (Table i) revealed that all the components of the later are with the permissible limits, the only exception being the BOD (Indian Standard institute, 1974, 1977) indicating the efficacy of the effluent treatment process. The test plant *Vigna radiata* used in the present investigation showed 100% seed germination in control water. The undiluted effluent is adversely affected the germination and vigour of the green gram . Simiiar observations were made by number of earlier workers (Kumawat *et al*. 2001, Sundaramoorthy *et al,* 2001; Mariappan and Rajan, 2002; Ramana, *et al*, 2002) The highest growth (root length, shoot length) was observed in plants registered with 25% effluent concentration at all growth stages studied under potted conditions (Table 2) it was comparable with the growth of plants irrigated with treated effluent treatment The maximum growth of plants treated with very dilute effluent may be attributed to reduction of concentration of constituents to beneficial level (Sahai *et al*, 1983). The undiluted effluent however, resulted in the retardation of growth. The reduction might be attributed to excess amount of solid materials and soluble salts in undiluted effluent (Rajaram *et at,* 1988). Treatment of plants with lower concentration (25%) and treated effluent on biochemical constituents such as Chlorophyll, Protein and Carbohydrate showed pronounced increase. Among the different age levels of *Vigna radiata* studied the forty dayjoid plants supported the maximum accumulation of bio- chemical contents. The higher concentrations decreased the contents gradually (Table 3). The similar line of research using dye factory effluent was studied by Jain and Khan (1996).

The impact of effluent dilutions on the yield of *Vigna radiata* was evaluated in terms of the number of pods per plant, pod length, number of seeds per plant, grain yield per plant and 1000 seeds weight The 25, 50 percent and treated effluent concentrate^gave significantly higher yield. The undiluted and 75% concentration,adversely affected the yield (Table 4). This is in agreement with Jabeen and Saxena (1990).

Significant changes in chemical characteristics of soil (Table 5 & 6) such as pH, EC, chlorides, nitrates, nitrogen, phosphorus, potassium and organic carbon of the treated soil registered increases over thaier control. Similar observations showing increases in the above said charactristics of the soil due to continuoues irrigation with the paper mill effluent (Kannan & Oblisami, 1990). The fact indicates that the available concentration of nutrients rather than total nutrient status of the soil determines the growth (Iqbal & Qadir,

Table - 1
Characteristics of the dye house effluent

Sr. No.	Parameter	Observation Raw	Treated	ISI tolerance limit
1.	Colour	Green, pink violet to brown	Dull white transparent	Colourless
2.	Odour	Not offensive	Not offensive	Odourless
3.	pH	8.8 to12	8.2	5.5-9.0
4.	EC (dSm^{-1})	1.98 $\pm$ 0.06	0.89 $\pm$ 0.03	-
5.	Suspended solids	2346 $\pm$ 415	260 $\pm$ 28	600 max
6.	Dissolved solids	4931 $\pm$ 819	804 $\pm$102	2100 max
7.	Dissolved oxygen	0.0 $\pm$ 0.0	208 $\pm$ 0.6	-
8.	BOD (5 days at 20^0C)	3894 $\pm$1216	5.25 $\pm$ 0.82	3.0 max
9.	COD	5949$\pm$ 2717	72 $\pm$13	250 max
10.	Total Nitrogen	100 $\pm$1.2	14.6 $\pm$ 0.9	-
11.	Total Phosphorus	16.4 $\pm$1.2	14.6 $\pm$ 0.9	-
12.	Total Potassium	28 $\pm$3	0.48 $\pm$ 0.13	-
13.	Sodium	246 $\pm$ 21	26 $\pm$ 4	60 max.
14.	Sulphate	218 $\pm$36	60 $\pm$ 8	1000 max.
15.	Chloride	427 $\pm$19	240 $\pm$ 21	600 max.
16.	Alkalinity	315 $\pm$ 13	122 $\pm$9	-

Table - 2
Effect of various concentrations of dyehouse effluent on the (A) shoot (cm) and (B) root length (cm) of green gram at different growth stagesunder pot condition

A. Effluent concentration (%)	Plant age (days) 20	40	60	80
Control	16.64 b	19.00 bc	23.56 d	26.64 b
25	17.66 b	20.08 ab	25.22 b	28.54 a
	(+ 6.1)	(+5.7)	(+7.0)	(+7.1)
50	17.02 b	17.18 c	24.76 bc	25.40 c
	(+2.2_	(-9.6)	(_5.1)	(-4.7)
75	14.18 a	17.36 c	24.00 cv	24.,1 d
100	13.52 a	14.30 d	23.46 d	18.04 e
	(-12.4)	(-24.7)	(-4.2)	(-51.7)
Treated effluent	17.2 b	21.82 a	26.72 a	26.42 bc
	(+3.4)	(+14.8)	(+13.4)	(-0.83)

B. Effluent concentration (%)	Plant age (days) 20	40	60	80
Control	7.26	9.98	13.76 b	15.62 bc
25	17.52a	8.94 b	13.72 b	16.16 ab
50	6.80 a	7.00 c	12.84 b	15.18 c
	(-9.9)	(-29.9)	(-6.7)	(-2.8)
75	5.59 b	6.42 c	11.16 c	13.9 d
	(-17.9)	(-35.7)	(-18.9)	(-11.0)
100	4.82 c	5.78 d	8.66 d	10.86 e
	(-33.6)	(-42.1)	(-37.1)	(-30.5)
Treated effluent	7.38a	10.16 a	15.02 e	10.88a
	(+1.7)	(+1.8)	(+9.2)	(+8.1)

Table - 3

Effect of various concentrations of dyehouse effluent on the (A) chlorophyll content (gg^{-1}) (B) protein content ($mg.g^{-1}$ leaf dry weight) (C) Soluble carbohydrate ($mg.g^{-1}$ leaf dry weight of green gram leaf at differnt growth

A

Effluent concentration (%)	Plant age (days) 20	40	60	80
Control	1.92 a	2.40 ab	2.00 ab	0.77 ab
25	1.95 a	2.32 ab	2.17 ac	0.78 ab
	(+1.6)	(-3.3)	(+8.5)	(+1.3)
50	1.94 a	2.51 ab	1.96 c	0.89 ab
	(+1.0)	(+4.6)	(-2.0)	(+14.7)
75	1.81 a	2.35 ab	1.69d	0.80 ab
	(-5.7)	(-2.1)	(-15.5)	(+3.9)
100	1.77 a	1.88 c	1.51 d	0.62 a
	(-7.8)	(21.7)	(-24.5)	(-19.9)
Treated effluent	2.01 a	2.59 b	2.16 bc	0.93 b
	(+4.7)	(+7.9)	(+8.0)	(+20.2)

B.

Effluent concentration (%)	20	40	Plant age (days) 60	80
Control	61.8 a	70.0 a	49.2 ab	24.8 ab
25	60.6 ab	70.1 a	57.4 ab	23.0 ab
	(-1.9)	(+ 0.14)	(+4.5)	(-7.3)
50	51.4 ba	64.0 b	48.2 a	18.2 c
	(-16.8)	(-8.6)	(-2.0)	(-28.0)
75	48.0 c	63.8 b	48.2a	17.2 c
	(-22.3)	(-8.9)	(-2.0)	(-30.6)
100	29.0 d	63.0 b	41.8 c	13.0 d
	(053.0)	(-10.0)	(-15.0)	(-47.6)
Treated effluent	60.8 ab	71.6 b	53.8 b	21.8 b
	(+1.6)	(+2.3)	(+9.3)	(-12.1)

C.

Effleunt concentration (%)	20	Plant age (days) 40	60	80
Control	99.2a	77.8 c	61.0 ab	32.0 a
25	97.0 a	86.2 b	66.0 c	40.2 d
	(-2.2)	(+10.8)	(+6.5)	(+25.6)
50	91.6 c	77.6 c	63.2 c	26.4 c
	(-7.7)	(-0.26)	(+1.9)	(-17.5)
75	90.0 d	70.6 b	50.6 d	26.0 c
	(-9.3	(-9.3)	(-18.4)	(-18.75)
100	88.0 e	62.2 a	41.8 e	23.0 d
	(-11.3)	(-20.1)	(-32.6)	(-28.1)
Treated effluent	104.o f	86.8	67.2 c	41.0 b
	+ 4.8)	(+11.6)	(+8.4)	(+21.9)

1973).

The study concludes that the dye house effluent contains an excess of various nutrients which are injurious to plant growth. Further experiments may be conducted to assess the significance of the nutrients. The concentration of the constituents should be diluted to 25% which can be used for irrigation purposes as substitute for chemical fertilziers.

Table - 4

Impact of the effluent dilution on the yield of Vigna Radiata under pot condition

Sr. No.	Yield Parameter	Control	Effluent concentration (%) 25	50	75	100	Treated effluent
1.	Pod length	6.8 c	7.8 a	7.3 b	7.3 b	6.1 d	7.6 ab
	(cm)		(14.7)	(+7.4)	(+7.4)	(-10.3)	(+11.8)
2.	Number of	50.2	54.8 a	46.2 c	41.6 d	35.8 e	55.8 a
	pods/plant		(9.2)	(-7.9)	(-17.1)	(-28.7)	(+11.2)
3.	Number of	10.4 c	11.6 b	12.6 a	9.0 d	7.4 e	12.0 ab
	seeds/pod		(+11.5)	(+20.8)	(-13.5)	(-28.8)	(+13.5)
4.	Grain Yield	20.8 c	25.8 a	21.1 c	15.5 d	10.8 e	23.7 b
	/Plants (g)		(24.1)	(+1.6)	(-25.3)	(-49.9)	(+14.2)
5.	1000 -Seeds	32.2 bc	34.1 cd	35.3 d	31.5	26.5 a	35.5 d
	weight (g)		(+5.7)	(+9.4)	(-2.1)	(-17.7)	(+10.2)

Table - 5

Impact of the effluent dilution on the chemical characteristics* of soil samples from pot culture prior to seed sowing

Sr. No.	Parameter	Control	Effluent concentration (%) 25	50	75	100	Treated effluent
1.	pH	6.8 f	7.4 e	8.1 c	8.3 b	8.9 a	7.9 a
			(+9.4)	(+18.5)	(+22.6)	(+29.4)	(+14.4)
2.	Electrical	0.16 c	0.34 b	0.34 b	0.38 b	0.52 a	0.361 b
	conductivity		(+112.5)	(+112.5)	(+137.5)	(+225.0)	(+125.0)
3.	Chlorides	38.3 e	51.1 d	63.9 c	76.7 b	102.2 a	51.1 d
	(mg/kg)		(+33.4)	(+66.8)	(+100.3)	(+166.8)	(+33.4)
4.	Nitrates	10.1 c	10.6 c	11.7 bc	14.0 b	18.5 a	11.2 bc
	(mg/kg)		(+4.9)	(+15.8)	(+38.6)	(+83.2)	(+10.2)
5.	Kjeldahl nitrogen	77.6 d	87.1 c	94.1 b	96.6 b	106.7 a	87.6 c
	(mg/kg)		(+12.2)	(+21.3)	(_24.3)	(+37.5)	(+12.5)
6.	Total	0.364 d	0.496 c	0.496 c	0.596 b	0.686 a	0.484 c
	phosphorus		(+36.3)	(+36.3)	(+63.7)	(+85.7)	(+32.9)
	(mg/kg)						
7.	Total potssium	0.103 d	0.102 d	0.111 c	0.123 b	0.133 a	0.108 cd
	(mg/kg)		(-1.0)	(+7.8)	(+19.4)	(+29.1)	(+1.9)
8.	Organic carbon	0.20 d	0.26 c	0.27 bc	0.29 b	0.32 a	0.25 c
	(5)		(+30)	(+35)	(+45)	(+60)	(+25)

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Table - 6
Effect of soil physico-chemical parameters post harvest soil samples

Sr No.	Parameter	Control	Effluent concentration (%) 25	50	75	100	Treated effluent
1.	pH	6.9 d	8.0 b (+16.3)	8.3 b (+20.3)	8.7 a (+26.5)	8.9 a (+29.4)	7.4 c (+8.7)
2.	EC (dSm^{-1})	0.26 b	0.26 b (0)	0.34 b (+42.3)	0.42 a (+61.5)	0.48 a (*4.6)	0.32 b (+23.1)
3.	Chlorides	120.12 c	135.58 bc (+12.9)	148.32 b (+19.3)	152.98 ab (+25.7)	166.20 a (+38.4)	138.19 bc (+15.0)
4.	Nitrates (mg/kg)	10.08 c	12.88 bc (+27.8)	10.08 c (0)	15.12 b (+50)	21.28 a (+111.1)	10.32 bc (+2.4)
5.	Kjeldahl nitrogen (mg/kg)	89.41 d	98.56 c (-10.2)	105.28 bc (+17.7)	108.88 b (+21.8)	118.44 a (+32.5)	101.92 bc (+13.9)
6.	Total Phosphorus (mg/kg)	0.33 e	0.41 d (+24.2)	0.41 d (+24.2)	0.52 b (+57.6)	0.64 a (+93.9)	0.44 c (+33.3)
7.	Total Potsssium (mg/kg)	0.109 d	0.113 d	0.118 c	0.149 b	0.144 a	0.112 a
8.	Organic carbon (%)	0.24 e	0.27 d (12.5)	0.30 c (+25.0)	0.32 b (+33.3)	0.38 a (+58.3)	0.26 d (+8.3)

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