Environment Conservation Journal 4(1-3) 83-91, 2003
(ISSN 0972-3099)

Effect of refinery effluent on seed germination seedling growth at nursery stage of *Vigna radiata*

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Abstract

The present investigation deals with the effect of refinery effluent on germination, shoot/root length, leaf, pods and seed yield of *Vigna radiata*. The seeds were grown in pots and treated with various concentrations of refinery effluent. Concentrations 0.5 and 1.0% and above were found to be deleterious while treated effluent with 0.01, 0.05 and 0.1% concentrations were found to be suitable for irrigation in comparison to ground water. A field experiment was also laid down and observations were interpreted that treated effluents can be effectively used for irrigation.

Key Words: ***Effluent, Refinery,Germination***

Introduction

Petroleum refinery unavoidably generates a large volumes of oil sludge, organics like n-alkanes-paraffins, olefins, aromatics, asphaltics, Phenols and Polynuclear aromatic hydrocarbons (Atlas 1981, Grob 1983) which have both lethal and Sub lethal effects on a wide variety of marine organism (Chet and Mitchell 1973), reduced photosynthetic rate in algae (Parker and Menzel 1974), reduced resistance to environmental stress in crabs (Krebs and Burns 1977) accumulation of hydrocarbons in fatty tissues of fishes which get transferred to higher trophic levels including humans (Shailubhai 1986) . Therefore, the concern over chronic hydrocarbon inputs in environment is ecologically mendatory and disposal of oil sludges and waste hydrocarbons is a major challenge prevailing in the petroleum industry.

Many prior attempts had been made to assess the characteristics of petroleum refinery wastes (Kale *et al.* 1981) and all reports suggest the researchers for regular assessment of this waste in order to obtain

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judicious data before effluents are used for irrigation, the deliberately cause deleterious effect in agroecosystems (Shailubhai 1986).

Study area and Methodology

Mathura oil refinery is located near Bad (Mathura District) in Uttar Pradesh processing about 15 lakhs tonnes of crude oil. The oil refinery discharges its pretreated effuents into Yamuna river through a 13.5 km long drain which is constructed with bricks and high slanting sides to avoid ground seepage of effluents. At about 0.5 km away from outlet of the drain, a pumping station has been installed which continuously transfer effluents to the irrigation canal distributing effluent and water to agricultural fields.

Experimental Layout

An experiment on Moong was conducted in the experimental field developed for this purpose, adjacent to the drain carrying treated effluent on Delhi-Agra Highway No. 2 one experiment on Moong was also conducted in pots at the experimental Net House of Botany Deptt. Raja Balwant Singh College, Agra. The study was conducted in a split plot design where main plot treatments effluent discharged from the refinery.

Design of the experiment	**Split plot**
Main plot treatment :	Irrigants (i) Ground water (ii) Treated effluent
Concentrations :	0.01% 0.05% 0.1%
Replications :	Three
Seed rate :	20 kg/ha
Fertilizer :	N10 P30 K35
Date of sowing :	22.4.2000
Irrigations (Four) :	8.05.2000 22.5.2000 08.6.2000 20.6.2000
Samplings :	30.40 and 50 DAS

The following growth, characteristics were studied :

0. Germination
1. Shoot length (cm) per plant
2. Root length (cm) per plant
3. Root nodule number per plant
4. Leaf number per plant
5. Shoot fresh weight (g) per plant
6. Shoot dry weight (g) per plant

Crops and Inputs

As mentioned earlier Moong *Vigna radiata* was selected for these studies. It was based on the fact that these crops are grown locally by the farmers and leguminous crops maintain the seed fertility. In field experiment each plot was irrigated with 2,500 liters of irrigant each time calculated in accordance with the size of the plot and local requirements. A 90^0 v-notch weir box was used for measuring the flow using the following formula.

$Q= 1417\ H^{2.5}$

where Q=discharge, 1/s and H height of irrigant over the apex of the notch cm.

Analytical Techniques

Irrigant and soil samples were analysed according to Standard Methods 1985 and Ghosh *et al*. 1983 respectively. Analysis for heavy metal content was done with the help of Atomic Absorption Spectro photometer.

Statistical Analysis

All the data for growth was analysed statistically according to panse Sukhtme 1985.

Results and Discussion

Most of the growth characteristics, studied at different intervals, exhibited a favourable response to the treated effluent as compared with ground water (Table 1-6). The application of the treated effluent favoured the vegetative growth of the plants, observed at 35, 42, 49 and 56 days after sowing. The respective leaf number per plant was 25.2, 13.0, 16.1 and 13.6% and shoot dry weight per plant was 33.3, 26.7, 38.7 and 27.1% more than ground water application.

The irrigation of Moong treated effluent enhanced the vegetative growth of the plants as compared with ground water. This luxuriant growth resulted in the improvement of all the characteristics

determining the reproductive growth in gram contrary to the 1% above in a similar pattern.
The decrease in leaf No. per plant was observed at 0.5, 1.0 and 1.5% refinery effluent and found that leaf number and shoot dry weight also decreased at this concentration.

The leaf number and shoot dry weight increased by 13.9 and 14.2% at 40 and 14.9 and 17.8% at day 50 respectively. Most of the interactions between irrigant and Moong were not significant (Table 1-6). Contrary to the growth, irrigation with treated effluent decreased seed yield in Moong which was 9.4% lower in comparison to the ground water. It would not be out of place to mention that the percent decrease in plant dry weight of gram due to the ill effect of effluent irrigation was only 3.3% in comparison with ground water above 0.1%. This shows that the plant dry weight in not adversely affected to the same extent as the other two concentration. All the interaction values between irrigant and concentration were not significant for plant growth attributing parameters.

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Table:- 1 : Effect of treated effluent (TE) and ground water (GW) on shoot length (cm) per plant at three concentrations at three stages of growth.

(Mean of three replicates)

	Days after sowing								
	30			40			50		
Concentration	TE	GW	Mean	TE	GW	Mean	TE	GW	Mean
0.01	28.65	26.11	27.38	39.10	36.88	37.99	43.55	39.44	
0.05	27.77	27.66	27.72	39.00	37.89	38.44	41.50		
0.1	31.07	27.22	29.14	44.30	41.55	42.93	47.22	42.06	
							44.64		
							54.77	49.00	
							51.89		
Mean	29.16	26.99		40.80	38.77		48.51	43.50	

CD at 5%

	30	40	50
Irrigants	1.10	0.68	3.03
Concentration	N.S.	1.05	0.82
Irrigants X Concentration	N.S.	N.S.	N.S.
Concentration X irrigants	N.S.	N.S	N.S.

N.S. – Not significant

Table:- 2 : Effect of treated effluent (TE) and ground water (GW) on shoot length (cm) per plant at three concentrations at three stages of growth.

(Mean of three replicates)

Concentration	Days after sowing								
	30			40			50		
	TE	GW	Mean	TE	GW	Mean	TE	GW	Mean
0.01	13.33	13.22	13.27	17.89	15.67	16.78	22.22	19.33	20.77
0.05	1277	13.33	13.05	20.85	23.77	22.31	25.78	21.89	23.83
0.1	14.78	14.22	14.50	23.85	20.22	20.03	31.33	27.99	29.66
Mean	13.83	13.58		20.86	19.88		26.44	23.07	

CD at 5%

	30	40	50
Irrigants	N.S.	N.S.	2.56
Concentration	N.S.	N.S.	1.26
Irrigants X Concentration	N.S.	N.S.	N.S.
Concentration X irrigants	N.S.	N.S	N.S.

N.S. – Not significant

Table:- 3 : Effect of treated effluent (TE) and ground water (GW) on shoot length (cm) per plant at three concentrations at three stages of growth.

(Mean of three replicates)

	Days after sowing								
	30			40			50		
Concentration	TE	GW	Mean	TE	GW	Mean	TE	GW	Mean
0.01	8.00	9.00	8.50	18.55	16.00	17.28	19.55	18.22	18.89
0.05	9.00	10.78	9.89	21.00	18.89	19.94	22.17	19.33	20.75
0.1	13.78	8.89	11.28	25.20	22.66	23.93	26.89	25.44	26.16
Mean	10.22	9.55		21.58	19.18		22.87	20.99	

CD at 5%

	30	40	50
Irrigants	N.S.	1.21	1.65
Concentration	0.93	1.02	1.26
Irrigants X Concentration	2.00	N.S.	N.S.
Concentration X irrigants	1.62	N.S	N.S.

N.S. – Not significant

Table:- 4 : Effect of treated effluent (TE) and ground water (GW) on shoot length (cm) per plant at three concentrations at three stages of growth.

(Mean of three replicates)

	Days after sowing								
	30			40			50		
Concentration	TE	GW	Mean	TE	GW	Mean	TE	GW	Mean
0.01	13.67	14.67	14.17	18.11	16.33	17.22	20.55	19.22	
0.05	14.33	13.22	13.78	19.00	16.44	17.72	19.89		
0.1	16.00	15.44	15.72	21.11	18.33	19.72	24.22	20.55	
							22.38		
							28.00	23.55	
							25.78		
Mean	14.67	14.44		19.40	17.03		24.26	21.10	

CD at 5%

	30	40	50
Irrigants	N.S.	2.03	1.42
Concentration	0.98	0.86	1.12
Irrigants X Concentration	N.S.	N.S.	N.S.
Concentration X irrigants	N.S.	N.S	N.S.

N.S. – Not significant

Table:- 5 : Effect of treated effluent (TE) and ground water (GW) on shoot length (cm) per plant at three concentrations at three stages of growth.

(Mean of three replicates)

	Days after sowing								
	30			40			50		
Concentration	TE	GW	Mean	TE	GW	Mean	TE	GW	Mean
0.01	10.22	10.55	10.39	18.86	17.33	18.00	23.96	20.94	22.45
0.05	10.06	9.22	9.62	19.55	16.88	18.22	27.33	23.18	25.26
0.1	10.22	10.44	10.33	22.66	22.66	22.66	33.77	29.32	31.54
Mean	10.17	10.17		20.29	18.95		28.35	24.47	

CD at 5%

	30	40	50
Irrigants	N.S.	1.25	2.37
Concentration	N.S.	0.60	0.73
Irrigants X Concentration	N.S.	1.25	N.S.
Concentration X irrigants	N.S.	1.04	N.S.

N.S. – Not significant

Table:- 6 : Effect of treated effluent (TE) and ground water (GW) on shoot length (cm) per plant at three concentrations at three stages of growth.

(Mean of three replicates)

Concentration	Days after sowing								
	30			40			50		
	TE	GW	Mean	TE	GW	Mean	TE	GW	Mean
0.01	3.59	3.48	3.53	6.21	5.87	6.04	8.25	6.95	7.60
0.05	3.35	3.08	3.21	6.51	5.75	6.13	9.32	7.86	8.59
0.1	10.69	3.48	3.44	7.70	6.23	6.96	11.50	9.88	10.69
Mean	3.45	3.34		6.81	5.95		9.69	8.22	

CD at 5%

	30	40	50
Irrigants	N.S.	0.77	0.76
Concentration	N.S.	0.20	0.45
Irrigants X Concentration	N.S.	0.54	N.S.
Concentration X irrigants	N.S.	0.35	N.S.

N.S. – Not significant