Research Article (Open access)

Effect of Rispana Sewage Wastewater on the Growth Parameters of Moong Bean Plant (*Vigna radiata)*

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Received: 19 March 2016/Revised: 13 April 2016/Accepted: 02 May 2016

ABSTRACT- For every life form, water is an essential natural element. Ever increasing growth of the population, especially in developing country like India, have affected not only the surface, but also ground water quality and is the main cause of environmental pollution. The most possible sources of soil, water and plant pollutions are sewage sludge, residues of industrial factories and intensive fertilization. Increased organic matter (from the sewage) breaking down in the river reduces the amount of dissolved oxygen in the water body as the decomposition process uses up the available dissolved oxygen. Microbial pathogens introduced by sewage into surface or groundwater can threaten public health, as well as affect ecosystem health and function. Today, as the demand for fresh water intensifies, the use of municipal or sewage wastewater as an alternative source of water for irrigation purpose is also a common practice. The present study was conducted to assess the physicochemical parameters of the Rispana river, where sewage is dumped and also the effect of this sewage wastewater on selected plant *Vigna radiata*. The findings of the study indicated a direct influence of sewage wastewater on the plantlets and decrease in overall growth of plant with increase in concentration of waste water.

Key-Words: Water pollution, Urbanization, Environmental effect, *Vigna radiata*

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INTRODUCTION

Wastewater is simply water that has been used. It usually contains various pollutants, depending on what it was used for. One of the serious environmental concerns of India is water pollution, where the majority of the population is exposed to poor water quality. In suburban areas, the use of industrial or municipal wastewater is common practice in many parts of the world including India [1]. The most possible sources of soil, water and plant pollutions are sewage sludge, residues of industrial factories and intensive fertilization.

Access this article online	
Website: www.ijlssr.com	**DOI:** 10.21276/ijlssr.2016.2.3.11
Quick Response Code:	

ISSN 2455-1716

The increasing pace of industrialization in public and private sectors along with urbanization, population explosion are reflected in varying degree of pollution of water, soil and air [2]. Physiochemical parameters of water are induced due to discharge of untreated or partially treated industrial waste and sewage waste into water bodies [3].

Cost of treatment of sewage water for recycling is too high to be generally feasible in developing countries like India. In most of the cases the untreated sewage either finds way to the nearest water bodies or is intentionally put into the agricultural fields by the farmers as a substitute for irrigation. Indiscriminate disposal of such water is a cause of pollution of air, soil and groundwater supplies. It can cause many environmental problems such as soil sickness, soil and ground water contamination and phytotoxicity. Sewage adversely affects many crops such as radish during maturity stage and as a result the production decreases substantially [4]. The water quality monitoring results carried out by CPCB (Central Pollution Control Board) particularly with respect to the indicator of oxygen consuming substances (biochemical oxygen demand, BOD) and the indicator of pathogenic bacteria (total coliform and fecal coliform) show that there is gradual degradation in water quality (CPCB 2009). During 1995–2009, the number of observed samples with BOD values less than 3 mg/l was between 57–69 percent; in 2007 the observed samples were 69 per cent. Studies have been carried out to understand the effect of sewage wastewater of Krishnapura nallah, Indore on growth parameters of *Trigonella foenumgraecum*, which showed positive as well as negative impact on the plant [5]. Keeping the above in view the study was undertaken to assess the effect of Rispana sewage wastewater on selected plant in term of growth parameters and also checking the physicochemical properties of the river.

MATERIALS AND METHODS

This study was carried out in the Department of Biotechnology, Sai Institute of Paramedical & Allied Sciences, Dehradun, Uttarakhand, college affiliated to Hemwati Nandan Bahuguna Garhwal University, Uttarakhand (Central University). The study was carried out during the period of February 2015- April 2015.

Study area

The capital city of Uttarakhand, Dehradun is located in the northern part of India. It is 236 km north of India's capital New Delhi. It is between latitudes 29 °58' N and 31°2'N and longitudes 77° 34' E and 78° 18'E. The study area selected was Rispana river. It is the part of the Ganga drainage system of the valley. The river originates from Mussoorie hills and is supported by natural spring. The river is tributary of the Song river, which finally discharges into Ganga.

Sample collection

The wastewater was collected from Rispana river, Dehradun in 5 BOD bottles and was taken to laboratory for analysis of physicochemical analysis and further again more sample wastewater was collected time to time for germination of moong bean seeds *in-vitro* condition.

Physicochemical Analysis

After collection, the sample was analyzed for the physicochemical properties. Different parameters- colour, odour, turbidity, pH, TDS, TSS, DO, BOD, COD, alkalinity were analyzed in laboratory.

in-vitro Effect of Wastewater on Plants

Healthy seeds of *Vigna radiata* were taken from the local market of Dehradun. Two different methods to germinate the seeds were followed i.e first method was to germinate seeds in culture tubes and agar plates while another was in plastic pots containing sterilized and non-sterilized soil.

Culture Tubes and Agar Plates

Seeds were sterilized and Media (100 ml each) was prepared in 6 conical flasks .Weighed quantity of agar-agar (2 grams) was added to the measured quantity of sewage wastewater with distilled water at 10%, 25%, 50%, 75% and 100% dilution naming the flasks as A_o for control (containing 100 ml distilled water), A1, A2, A3, A4 and A5 for varying concentration of wastewater and distilled water respectively. The seeds were germinated using this sterilized medium in different sets of culture tubes and agar plates. They were then incubated at 25℃ for 3 and 5 days respectively.

Seed Germination in Pots

Seeds were cultivated in two cultivation groups:

SET I: Consisting of sterilized soil pots labelled as ST_o (control), ST1, ST2, ST3, ST4 and ST5 consisting of five treatments (10:90; 75:25; 50:50; 25:75; 0:100) i.e mixing proportions of sewage wastewater with tap water (sewage wastewater: tap water). The 100% tap water served as the control (ST_o). As such, most concentrated wastewater is used in ST5 and least in ST1. There were 3 replicates of each treatment.

SET II: Consisting of non-sterilized soil, pots labelled as NST_o (control), NST1, NST2, NST3, NST4 and NST5 and 3 sets of each were used for growing the plant. After sowing the seeds the same procedure was followed as above with varying concentration of wastewater as NST1, NST2, NST3, NST4 and NST5 consisting of five treatments (10:90; 75:25; 50:50; 25:75; 0:100).

Three moong bean seeds per control and pots were prepared in equal soil and cultivation condition in both the groups. The seeds were irrigated after every 2 days with equal amount of proportionately mixed water and the seeds irrigated with distilled water were taken as control 3 sets in each concentration were maintained along with the control for comparison.

RESULT AND DISCUSSION

Physicochemical analysis of Rispana sewage wastewater

Table 1: The Physicochemical parameters of Rispana wastewater

S. No.	Parameter	Result
1.	Colour	Turbid
2.	pH	7.25
3.	TDS	50 ppm
4.	TSS	45 ppm
5.	DO	7.1 mg/L
6.	BOD	1.9 mg/L
7.	COD	6.1 mg/L
8.	Alkalinity	220 mg/L

Morphological analysis of Moong bean plants

The effect of various concentrations of sewage wastewater on seed germination of Moong bean plant *in-vitro* (Petri-plates & culture tubes)

Table 2: SET A (Germination in Petri-plates)

S. No.	Shoot length (cm.)	Root length (cm.)	No. of leaves	Fresh weight (gm)	Dry weight (gm)
A_o	8.60	3.94	3	0.32	0.25
A1	8.52	3.80	2	0.31	0.20
A2	7.18	2.78	2	0.27	0.15
A3	7.50	2.42	2	0.28	0.16
A4	4.12	1.54	1	0.22	0.11
A5	2.70	1.00	1	0.19	0.10

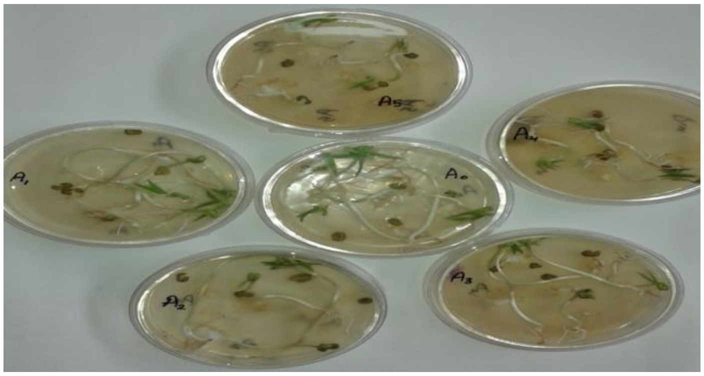

Fig. 1: Effect of various concentrations of sewage wastewater on seed germination of Moong bean plant (Petri-plates)

Table 3: Set B (Germination in Culture Tubes)

S. No.	Shoot length (cm.)	Root length (cm.)	No. of leaves	Fresh weight (gm)	Dry weight (gm)
A_o	16.0	8.73	2	0.37	0.22
A1	12.9	6.83	2	0.30	0.14
A2	11.8	6.06	2	0.31	0.16
A3	12.3	3.33	2	0.33	0.15
A4	13.2	1.93	2	0.34	0.20
A5	9.7	1.73	1	0.33	0.15

A_o- Control (normal tap water), A3- 50% wastewater
A1- 10% wastewater, A4- 75% wastewater
A2- 25% wastewater, A5- 100% wastewater (i.e undiluted)

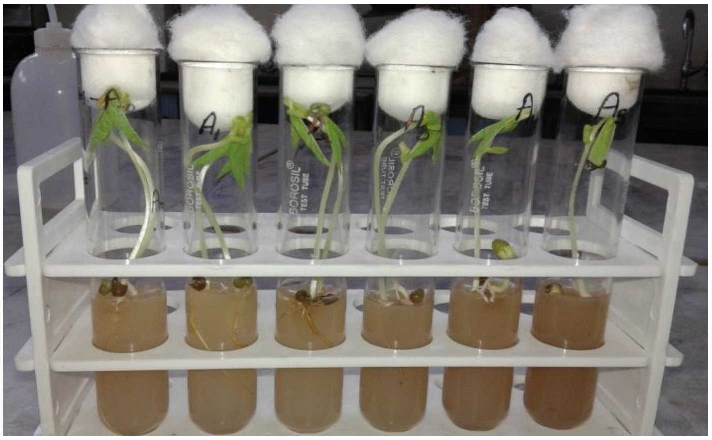

Fig. 2: Effect of various concentrations of sewage waste water on Seed germination of Moong bean plant *in-vitro* (Culture tubes)

The effect of various concentrations of sewage wastewater on seed germination of Moong bean plant in pots (non-sterilized soil and sterilized soil)

Table 4: Set A (Germination in Non Sterilized Soil)

S. No.	Shoot length (cm.)	Root length (cm.)	No. of leaves	Fresh weight (gm)	Dry weight (gm)
A_o	13.80	3.73	2	0.43	0.18
A1	12.06	3.43	2	0.35	0.17
A2	11.36	2.96	2	0.32	0.10
A3	10.43	2.96	2	0.28	0.14
A4	9.26	2.60	2	0.31	0.06
A5	5.70	1.33	2	0.17	0.04

A_o- Control (normal tap water), A3- 50% wastewater
A1- 10% wastewater, A4- 75% wastewater
A2- 25% wastewater, A5- 100% wastewater (i.e undiluted)

Fig. 3: The effect of various concentrations of sewage wastewater on Seed germination of Moong bean plant in pots (non-sterilized soil)

Table 5: SET B (Germination in Sterilized Soil)

S. No.	Shoot length (cm.)	Root length (cm.)	No. of leaves	Fresh weight (gm)	Dry weight (gm)
A_0	13.06	3.90	3	0.39	0.17
A1	12.76	3.33	2	0.40	0.14
A2	11.73	3.10	2	0.40	0.15
A3	11.33	3.80	2	0.29	0.14
A4	9.40	3.20	2	0.30	0.06
A5	9.00	1.63	2	0.29	0.04

A_0- Control (normal tap water), A3- 50% wastewater
A1- 10% wastewater, A4- 75% wastewater
A2- 25% wastewater, A5- 100% wastewater (i.e undiluted)

Fig. 4: The effect of various concentrations of sewage wastewater on seed germination of Moong bean plant in pots (sterilized soil)

Using wastewater for growing the moong bean plantlets decreased the physiological parameters in all the sets. Maximum root length of the overall study was found in culture tubes in control (i.e 8.73 cm). Root length decreased with increase in concentration of sewage wastewater. It is in accordance with the findings of Augusthy and Sherin [6] who stated that root length of *V. radiata* increase in low concentration of effluents. Shoot length showed a significant lower value in waste water irrigated plants as compared to the controls. Overall maximum shoot length was found in culture tube in the control (i.e 16 cm). Fresh weight and dry weight were decreasing after application of wastewater as compared to control conditions. The literature reveals that micronutrients found in waste water may be beneficial for plant growth, but several factors may produce undesirable effects on plants at higher concentration. And this is supported by present data which indicated that visible symptoms of toxicity appeared in plants irrigated with higher concentration of wastewater, such as brown spots on leaf and chlorosis and ovate shape with curling in leaf margin. Colour of leaf as green is observed in plants irrigated with control and low concentration of wastewater. The effect of wastewater on germination was discourageable towards higher concentrations. The effect of sewage water on seedling growth was suitable in the lower concentration (25%), whereas the higher concentration (50, 75, and 100%) was inhibitory in untreated.

CONCLUSIONS

The main purpose of the study of physicochemical parameters of the river was to determine the pollution status of the river and also its effect on plant. On the basis of above observations, it becomes clear that the water is not at all fit for drinking and other domestic purposes. After analysing it was concluded that the water of Rispana river need some treatment before its use. Also the effect of different dilution of wastewater on plant growth showed that the highest decrease in every parameter was found at 75% and 100% dilution of sewage in every set. Results revealed that waste water irrigation brought up negative changes in most of the important growth parameters of plant and hence this wastewater is not found suitable for crop irrigation but can be used for irrigation purposes in agricultural practices after proper dilutions. It is also suggested that, treatment of sewage is necessary to minimise the pollution effects before it is discharged.

ACKNOWLEDGMENT

I convey my sincerest gratitude to my supervisor, Mr. Utkarsh Singh, Head, Department of Biotechnology, Sai Institute of Paramedical and Allied sciences, Dehradun for providing me an opportunity to carry out research work under his helpful guidance.

REFERENCES

[1] Rai S, Chopra AK, Pathak C, Sharma K, Sharma R and Gupta PM (2011) Comparative study of some physicochemical parameters of soil irrigated with sewage water and canal water of Dehradun city, India. *Archives of Applied Science Research,* 3(2): 318-25.

[2] Bamniya BR, Kapasya V and. Kapoor CS (2010) Physiological and biochemical studies on the effect of waste water on selected crop plants. *An International Journal,* 2(2): 0975-1130.

[3] Mangukiya R, Bhattacharya T. and Chakraborty S (2012) Quality Characterization of Groundwater using Water Quality Index in Surat city, Gujarat, India. Int Res J Env Sci, 1(4): 14-23.

[4] Bakhsh K and Hassan S (2005) Use of sewage water for radish cultivation: A case study of Punjab, Pakistan. *J Agric Soc Sci,* 4: 322-26.

[5] Pathrol M and Bafna A (2013) Effect of sewage on Growth Parameters and Chlorophyll content of *Trigonella foenumgraecum* (Methi). International Research Journal of Environment Sciences, 2(9): 2319–414.

[6] Augusthy PO and Sherin MA (2001) Effect of factory effluents on seed germination and seedling growth of *Vigna radiate* L. *Journal of Environmental Research,* 22: 137–39.

