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Research Article

IMPACT OF JUTE MILL WASTE WATER ON SEED GERMINATION AND VIGOUR INDEX OF *CICER ARIETINUM* L. AND *PISUM SATIVUM* L.

Sankar Narayan Sinha* and Dipak Paul

Environmental Microbiology Research Laboratory, Department of Botany, University of Kalyani, Kalyani, West Bengal, India

*Correspondence

Sankar Narayan Sinha
Environmental Microbiology Research Laboratory,
Department of Botany, University of Kalyani, Kalyani,
West Bengal, India

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ABSTRACT

The main objective of this paper is to determine the effects of jute mill waste water on seed germination and seedling growth of *Cicer arietinum* and *Pisum sativum* plants under laboratory conditions. The effect of jute mill waste water was compared to that of control (distilled water). Jute mill waste water at different concentrations (10, 20, 30, 40, 80 and 100 %) influenced the seed germination and vigour index of *C. arietinum* and *P. sativum*. It was concluded that jute mill waste water has significantly played a profound role on the germination and growth of seeds and seedlings of *Cicer arietinum* and *Pisum sativum*.

Keywords: *Cicer arietinum*, *Pisum sativum*, Vigour index, Jute mill waste water

INTRODUCTION

Large amount of industrial effluent is being produced in various metropolitan cities owing to ever increasing population. There is an increase in the utilization of industrial effluents for irrigation purposes particularly in the outskirts of the cities especially in the dry areas where there is scarcity of water. Different industrial effluents rich in organic matter and other nutrients finds agricultural application as cheaper way of disposal[1,2]. The use of industrial effluents for irrigation purpose has emerged in the recent times as an important way of utilizing waste water. There are several advantages and disadvantages in using this industrial waste water for irrigation purpose[3,4]. Waste water from different industries consists of higher amounts of nutrients which substantially increases crop yield and minimize the requirement for fertilizer and ultimately reduces the overall production cost. In addition to providing large quantities of water, waste water from different industries contains large amount of organic matter and essential nutrients (N, P, K, Ca, S, Cu, Mn and Zn) which are found to be beneficial for plants and increase crop yield[5-7]. Use of industrial effluent on agricultural land now-a-days has become a common practice in India. The toxic metals present in the effluent can be transferred and accumulated into plant tissues from the soil. Jute textile manufacturing is the most important industry in West Bengal due to availability of raw jute in the state. A number of jute mills are present along the banks of river Ganga in West Bengal, India and is a principal contributor to the pollution[8]. Although few attempts have been made by different authors to determine the effect of various effluents discharged from different industries on seed germination of various crops but no comprehensive study of effect of jute mill waste water on seed germination of *Cicer arietinum* and *Pisum sativum* has not been investigated in details[9-12]. Here, an attempt has been made to assess the physico-chemical properties of jute mill waste water and their impact on the seed germination and seedling vigour of *Cicer arietinum* and *Pisum sativum* at different concentrations.

MATERIALS AND METHODS

Collection of water sample

Jute mill waste water sample of about 1 litre was collected from S.S.J. jute mill, Pincol, Shyamnagar, West Bengal, India in polyethylene bottles from the point where the jute mill waste water enters the field for irrigation of *Cicer arietinum* and *Pisum sativum* crop. Water samples were immediately taken to laboratory and analysed for different physico-chemical parameters.

Physico-chemical characteristics of jute mill waste water

Jute mill waste water was analyzed for different physico-chemical parameters such as pH, temperature, electrical conductivity, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), sulfate, chloride, total dissolved solids (TDS), total solids (TS), total suspended solids (TSS), hardness, total alkalinity and nitrogen through the method laid down in APHA (2005)[13].

Effect of jute mill waste water on seed germination

Different variety of *Cicer arietinum* and *Pisum sativum* seeds were surface sterilized with 0.1 % $HgCl_2$ solution. After treatment with $HgCl_2$, seeds were washed three times to remove all the traces of mercury. Seeds were then soaked for 2-3 h in distilled water. Different concentrations of effluent (10 %, 20 %, 30 %, 40 %, 80 % and 100 %) were prepared along with control (0 % effluent). Fifteen seeds were kept in pre-labelled Petridishes (lined with filter paper). Then 5 ml of each treatment (effluent concentration) were added in respective petridishes, which were then placed in dark for two days for germination, after three days, petridishes were placed under illumination. Nutrient solution was prepared and effluent concentrations were made with nutrient solution.

On third day of germination, 15 ml of nutrient solution was given and seedlings were harvested after 10 days of growth.

Determination of vigour index

Germinated seedlings were assessed for vigour index (VI). The root and shoot length of germinated seedling were measured and vigour index was calculated using the formula given by Abdul-Baki and Anderson (1973)[14].

$$VI = (MRL + MSL) \times PG$$

Where, VI = Vigour index; MRL=Mean root length; MSL= Mean shoot length; PG = Percentage germination.

RESULTS

In the present investigation, jute mill waste water which is used for irrigation of *Cicer arietinum* and *Pisum sativum* fields was analyzed for physico-chemical parameters and effect of waste water on seed germination and vigour index. The physico-chemical parameters of jute mill waste water are presented in the Table 1. The jute mill waste water used for the present investigation was dark in colour and was alkaline in nature. The average values of various physico-chemical characteristics of the jute mill waste water exhibited high chemical oxygen demand (360 mg/l), total dissolved solids (2040 mg/l), chloride (1050 mg/l) and sulfate (1100 mg/l).

In this study, it was observed that treatment jute mill waste water showed a high impact on *Cicer arietinum* seed germination. Seed germination percentage was similar at 10 % and 20 % jute mill waste water with that of the control (100 %). Increase in jute mill waste water concentration from 30 % onwards reduced the percentage of seed germination (Table 2). The vigour index of *Cicer arietinum* was found to be maximum at 20 % jute mill waste water concentration over control (Table 3). So it revealed that 20 % jute mill waste water concentration was suitable for higher seed germination and vigour index. The nutrient supplemented jute mill waste water however showed less vigour index at 10 %, 20 % and 30 % jute mill waste water concentration than that of control (Table 4). The dry weight of *Cicer arietinum* seed was recorded maximum in 20 % jute mill waste water concentration. Higher concentration of jute mill waste water reduced the dry weight of *Cicer arietinum* seed (Table 5). In case of *Pisum sativum* seeds, it was observed that the seed showed response to jute mill waste water treatment. Seed germination percentage was higher in the control set than that of the other concentration of jute mill waste water. Increase in jute mill waste water concentration from 10 % onwards reduced the germination percentage (Table 6). The vigour index of *Pisum sativum* was maximum at 0 % jute mill waste water concentration i.e. control set (Table 7). Therefore the higher percentage of jute mill waste water was not found to be suitable for higher seed germination and vigour index. The nutrient supplemented jute mill waste water, however, showed less vigour index at 10 % and 20 % jute mill waste water concentration that that of control (Table 8). The dry weight of seed was maximum in control set, whereas jute mill waste water reduced the dry weight of *Pisum sativum* seed (Table 9).

Table 1: Physico-chemical parameters of water

Parameters	Jute mill waste water	Control water
pH	9.3	7.3
Temperature (^{o}C)	30.2	28
EC (µS/cm)	18.97	400
DO	2.7	5.0
BOD	185	100
COD	360	250
TDS	2040	500
TSS	740	19
Nitrogen	65.9	0.20
Total alkalinity	500	300
Chloride	1050	200
Sulfate	1100	200
Hardness	870	300

Except pH, temperature and EC all others parameters are expressed in mg/L

Table 2: Effects of different concentration of jute mill waste water on seed germination percentage of *Cicer arietinum*

Jute mill waste water concentration (%)	Percentage of germination
Control	100.00
10	100.00
20	100.00
30	86.67
40	80.00
80	66.67
100	53.34

Table 3: Effect of different concentration of jute mill waste water on vigour index of *Cicer arietinum*

Jute mill waste water concentration (%)	MRL (cm)	MSL (cm)	PG	VI= (MRL + MRL) x PG
Control	1.70	1.09	100.00	279.30
10	1.24	1.06	100.00	230.00
20	2.23	1.03	100.00	325.20
30	1.49	0.79	86.67	197.52
40	0.82	0.19	80.00	80.96
80	0.77	0.11	66.67	59.06
100	0.37	0.00	53.34	19.52

Table 4: Effect of different concentration of jute mill waste water on vigour index of *Cicer arietinum* (after nutrient supplement)

Jute mill waste water concentration (%)	MRL (cm)	MSL (cm)	PG	VI= (MRL + MRL) x PG
Control	7.20	17.93	100.00	2513.30
10	2.14	7.34	100.00	948.60
20	1.75	6.05	100.00	781.20
30	1.79	2.57	86.67	377.79
40	0.99	0.61	80.00	127.92
80	0.92	0.60	66.67	101.34
100	0.37	0.00	53.34	19.52

Table 5: Dry weight of *Cicer arietinum* seed

Jute mill waste water concentration (%)	Dry weight (g)
Control	3.12
10	3.19
20	3.25
30	3.11
40	3.02
80	2.98
100	2.83

Table 6: Effect of different concentration of jute mill waste water on vigour index of *Pisum sativum*

Jute mill waste water concentration (%)	Percentage of germination
Control	100.00
10	80.00
20	70.00
30	70.00
40	60.00
80	40.00
100	30.00

Table 7: Effect of different concentration of jute mill waste water on vigour index of *Pisum sativum*

Jute mill waste water concentration (%)	MRL (cm)	MSL (cm)	PG	VI= (MRL + MRL) x PG
Control	1.99	1.06	100.00	305.00
10	0.74	0.42	80.00	92.80
20	0.54	0.17	70.00	49.70
30	0.39	0.08	70.00	32.90
40	0.24	0.03	60.00	16.20
80	0.13	0.00	40.00	5.20
100	0.07	0.00	30.00	2.10

Table 8: Effect of different concentration of jute mill waste water on vigour index of *Pisum sativum* (after nutrient supplement)

Jute mill waste water concentration (%)	MRL (cm)	MSL (cm)	PG	VI= (MRL + MRL) x PG
Control	6.50	11.80	100.00	1830.00
10	2.44	4.35	80.00	543.20
20	1.28	1.99	70.00	228.90
30	1.27	1.55	70.00	197.40
40	0.79	1.00	60.00	107.40
80	0.50	0.79	40.00	51.60
100	0.26	0.21	30.00	14.10

Table 9: Dry weight of *Pisum sativum* seed

Jute mill waste water concentration (%)	Dry weight (g)
Control	3.48
10	3.23
20	3.16
30	3.08
40	2.74
80	1.87
100	1.52

DISCUSSION

The present study indicated the utility of jute mill waste water for enhancement of seed germination in *Cicer arietinum* and *Pisum sativum* for their crop productivity. The physico-chemical parameters of jute mill waste waters contained several organic compounds that provide nutrients to the plant seed for quick germination. Such physico-chemical analysis was conducted for textile mill effluents by other author in relation to irrigation purpose[15]. The present investigation revealed that higher concentration of jute mill waste water inhibited germination of seed as a result of production of different enzymes[16,17] or by enriching the salinity (chloride content) and conductivity of solute being absorbed by seed prior to germination[18] or sometimes the seeds are found to be under physiological stress due to increased salinity[19] or excess amount of trace elements, heavy metals and toxic chemicals[20,21]. Present work is intended on germination behaviour of *Cicer arietinum* and *Pisum sativum*

seeds at different concentrations to find out the effect of jute mill waste water.

CONCLUSION

Use of jute mill waste water for irrigation purposes is a highly warranted utility of water polluted propositions. The objective of using waste water for irrigating crop plants is twofold. The first and foremost of these is the safe disposal of the waste water, which may otherwise have adverse effects on the environment and the health of human beings; another objective is to utilisation of jute mill waste as irrigation water, as compared for its possible fertilizer value. In the present study, jute mill waste water is used for cultivation of *Cicer arietinum* and *Pisum sativum* was analyzed to get an idea of physico-chemical properties of jute mill waste water and its effect on seed germination and vigour index. Jute mill waste water exhibited high COD, TDS, chloride and sulfate. The jute mill waste water was alkaline and in case of gram seeds, percentage of seed germination was higher at 10 %, 20 % and 30 % jute mill waste water concentration than that of control. Increase in jute mill waste water concentration from 30 % onwards reduced the germination percentage. *Cicer arietinum* showed maximum vigour index at 20 % jute mill waste water concentration over control. So it to reveal that 20 % jute mill waste water concentration was found to be suitable for higher seed germination and vigour index. The nutrient supplemented jute mill waste water however, showed less vigour index at 10 %, 20 % and 30 % jute mill waste water concentration than that of control. In case of *Pisum sativum*, it was found that the vigour index is maximum at control and it revealed that jute mill waste water is not suitable for its higher seed germination and vigour index.

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