Environment Conservation Journal 19 (3) 173-177, 2018
ISSN 0972-3099 (Print) 2278-5124 (Online)
Abstracted and Indexed

Impact of textile wastewater on germination and growth of Pisum sativum L.

Gupta Mehak ✉

Received: 21.03.2018 **Revised: 21.06.2018** **Accepted: 11.08.2018**

Abstract

The use of industrial waste water for irrigation purposes has emerged an important way to utilize its nutrients and removal of its pollutant load by growing tolerant plant species. The present study is an attempt to find out the ways in which the otherwise harmful industrial effluent can be beneficial used especially for agricultural purposes. The present study has been made to evaluate the output of textile effluent on germination and crop growth using *Pisum sativum* L. var Arkel. Plants were raised first in petri dishes and then in plastic pots in triplicate and irrigated with various concentrations of effluent. It was suggested that waste water from textile factory could be utilized for irrigation purposes after proper dilution and may contribute, at least in part towards solving the problem of textile effluent disposal. However, such recommendation needs some more extensive work to minimize the risk.

Key words: Industrial effluent, Pisum sativum, germination.

Introduction

Industrialization is gradually becoming the keyword in the developmental process of the developing nations of the world (Bhutiani and Ahamad, 2018). Industry has played a key role in shaping modern civilization. Even now rapid industrialization is viewed as a panacea for solving most of the man's needs as well as eradicating poverty. Industry is the major cause of large scale pollution of environment (Trivedy, 2002; Bhutiani *et al.*, 2016; Khanna *et al.*, 2014). Textile industry plays an important role in the industrial development of India and is the second largest sector of the Indian economy, next to agriculture. Among various industries, textile industry is equally considered as an intensive water consuming activity besides utilizing a wide variety of chemicals and dyes water. Various physicochemical characteristics of textile industry wastewater include pH 9.25, turbidity 100 NTU , specific conductivity 100,000 micro mho/cm, dissolved oxygen 8.8mg/l , biochemical oxygen demand 200 mg/l , chemical oxygen demand 1840 mg/l , total solids 20,000 mg/l, total dissolved solids 1000ppm and alkalinity 601.2mg/l (Sowmeyan, 2002). The coloured wastewater from textile industry interferes with the photosynthetic activity of plants since it impedes solar radiation penetration.Several investigations have been carried out to find out the effect of industrial effluent on germination of crops (Veena *et al*., 1992; Karande *et al.*, 1993; Shahidruhina, 1995; Dutta and Boissya, 1996), still many crops have been left which can be screened for their effluent tolerance capacities. Keeping these facts under consideration, the present study has been undertaken to study the effect of textile mill effluent of Chenab Textile Mills on various germination and growth parameters of Pea (*Pisum sativum* L.var, Arkel)

Author's Address
Department of Environmental Sciences, University of Jammu, Jammu-180006, India.
E-mail.: *gupt.mehak8@gmail.com*

Materials and Methods

Collection of effluent: The untreated effluent used in the study was obtained at regular intervals from Chenab Textile Mills, Kathua. Physico-chemical analysis of effluent: The effluent was analysed for its physico-chemical characterstics like temperature, pH, electrical conductivity, total dissolved solids, chloride and chemical oxygen demand using standard procedures of APHA, 1998; Trivedy and Goel, 1986 and Khanna and Bhutiani, 2008.

Experimental setup: Six treatment sets were prepared. One treatment set was kept as control (C) and tap water was used for irrigation in this set

Copyright by ASEA
All rights of reproduction in any form reserved

while other five sets were irrigated with different concentrations i.e 20% (T1), 40% (T_2), 60% (T_3), 80% (T_4) and 100% (T_5) of effluent concentrations, respectively. Earthen pots were filled with soil and farm yard manure. Three replicated were prepared for each treatment.

Germination parameters: After six days of sowing, the number of seedlings emerging in each replicate was noted regularly after every 2 days interval. Using this data, following indices were constructed

a) Germination index: Germination index was expressed as a percentage and calculated using following formula:

b) Delay Index (DI): Delay index was calculated to compare the performance of crop under different effluent concentration as given below:

Delay index (DI) = X/Y

Where X= delay in germination time over control

Y = germination time for control

Similarly, some other parameters like, percent inhibition, germination value, peak value, speed of germination and germination time were also estimated using formulae adopted from Rao *et al.* ,1979 and Czabator, 1962.

Growth Parameters: Seedlings of *Pisum* were uprooted from earthen pots and impact of treated textile wastewater on growth parameters (shoot length, root length, root shoot ratio and number of stipules) were studied.

Formula for GI

$$GI = \frac{number\ of\ seeds\ in\ sample}{number\ of\ seeds\ grown\ in\ control} \text{x} \frac{average\ sum\ of\ root\ length\ in\ sample}{average\ sum\ of\ root\ length\ in\ control} \text{x } 100$$

Effluent analysis: Analysis of both treated and untreated effluent was done for various physicochemical characteristics. Table 1 shows physicochemical characteristics of both untreated and treated effluent from Chenab textile mills. Great decrease in the values of certain physicochemical characteristics of treated effluent was observed. The value of total dissolved solids for untreated effluent was 2496.0 mg/l whereas for treated effluent was 1280.0 mg/l. Similarly, the values of total suspended solids (34.4 mg/l), osmotic pressure (1404.0 atm) and chloride (1249.6 mg/l) were observed for untreated effluent. On the other hand, for treated effluent the values of parameters viz., total suspended solids (20.0 mg/l), osmotic pressure (720.0 atm) and chloride (849.7mg/l) were observed. A more or less similar trend of results was observed by Bhutiani *et al.*, 2017 and Bhutiani *et al.*, 2015. Germination parameters: The effect of effluent on various germination parameters like germination index, delay index, speed of germination, peak value, percent inhibition, germination period, germination value etc is given in Table 2. Maximum value of all the parameters were observed in the control set (C) i.e, set in which tap water was used for irrigation. However, a gradual decline in the values of effluent. Table 2 reveals that the negative germination parameters viz., delay index and percent inhibition were lower in case of treatment set C and then increased with an increase in effluent concentration. The results showed that there exists a specific correlation between effluent concentration and germination parameters. The decrease in the germination parameters and inhibition of seed germination at higher concentrations can be attributed to the accumulation of toxic elements like chromium, lead, and zinc present in the effluent. The results are in conformity with the work of Rivard and Woodland (1989), on the effect of dyeing and matchwork effluent *Typha angustata* seeds that maximum germination occurred in the distilled water.The decrease in the germination parameters and inhibition of seed germination during effluent irrigation can be attributed to the accumulation of toxic elements even at lower concentrations (Rajannan and Oblisami, 1979; Mishra and Sahoo, 1989; Mishra and Behera, 1991). The inhibition of seed germination at higher concentration of the effluent may also be due to the high level of dissolved solids which increase the salinity and conductivity of solute absorbed by seed before germination (Sundaramoorthy and Kunjithapatham, 2000). Growth parameters: The effect of effluent was also studied on various growth parameters of Pea *(Pisum sativum L.)*. viz, shoot length , root length , root shoot ratio and number of stipules (Table 3). Growth parameters were found to be maximum in the treatment set irrigated with normal tap water. The other treatment sets with different effluent concentrations showed retarded growth. The growth parameters showed a decreasing trend

Table 1 :- Physicochemical characteristics of effluent released from Chenab textile Mill

Parameters	Untreated effluent	Treated effluent
Temperature	50.0	35.0
Colour	Greenish black	Light brown
Odour	Unpleasant	Odourless
pH	8.5	8.1
Total Suspended Solids (mg/l)	34.4	0.009
Total dissolved solids (mg/l)	2496.0	1280.0
Turbidity (NTU)	20.0	9.0
COD (mg/l)	1420.8	537.6
Electrical conductivity (mS/cm)	3.9	2.0
Osmotic pressure (atmospheres)	1404.0	720.0
Chloride (mg/l)	1249.6	849.7

Table 2 Effect of different effluent concentration on various germination parameters of *Pisum sativum* L.

Parameters	Treatments *					
	C	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**
Delay Index	--	0.00	0.13	0.13	0.13	0.31
Speed of germination	2.68	2.29	2.12	1.99	1.68	1.39
Peak Value	2.78	2.58	2.47	2.47	2.08	1.88
Germination value	216.01	186.27	171.42	171.42	121.26	99.07
Percent inhibition	---	5.50	8.30	8.30	19.40	25.00
Germination period	13.00	13.00	15.00	15.00	15	19.00
Germination Index	---	90.76	84.64	71.20	59.25	50.92
Commutative % germination	77.70	72.20	69.40	69.40	58.30	52.70

*C: tap water; T_1, T_2, T_3, T_4 and T_5: 20, 40, 60, 80 and 100% of treated textile effluent, respectively

Table 3. Effect of different concentration of effluent on growth parameters of *Pisum sativum* L.

Treatment *	Growth parameters			
	Root length	**Shoot length**	**Root -shoot length**	**Number of stipules**
C	8.90	12.99	0.68	10.0
T_1	8.81	12.98	0.67	7.60
T_2	8.30	12.50	0.66	6.66
T_3	7.21	10.90	0.66	6.30
T_4	7.07	10.67	0.65	6.00
T_5	6.82	10.52	0.64	5.00

*C: tap water; T_1, T_2, T_3, T_4 and T_5: 20, 40, 60, 80 and 100% of treated textile effluent, respectively with increase in effluent concentration. The maximum shoot length as found in case of control treatment set C and minimum shoot length (10.52 cm) was found in case of treatment set T_5 i.e. 100 % of effluent concentration.

Also, the effect of textile effluent on root-shoot ratio of *Pisum sativum L*. in terms of length revealed that the maximum root length, shoot length and root-shoot ratio was in control treatment set C (0.68) followed by T_1 (0.67), T_2, T_3 (0.66), T_4 (0.65) and T_5 (0.64). Reduction in root and shoot length at higher concentrations of effluent was attributed to high salinity. Number of stipules in *Pisum sativum* L. were minimum (5.0) in the treatment set T_5. The decrease in the number of stipules with an increase in the toxicity of effluent may be due to the higher concentrations of salts. The results of growth parameters are consistent with the findings of Kaushik *et al.,* (2005) who studied the effect of textile effluents on growth performance of wheat cultivars and found that the untreated textile effluent was totally unfit and toxic for use in agriculture and treated effluent was beneficial only at very low concentrations of effluent.

Conclusion

Maximum germination and growth were obtained in control set and after that the various concentrations of effluent were found to be inhibitory for germination and growth parameters. It has been concluded that effluent from CTM had a negative impact on germination and growth of plants. It can be elucidated from the present study that the textile effluent cannot be used as a potent irrigant for agricultural fields because of its highly toxic nature. However, effluent concentration lower than 20% could be tested to check any possibility of utilization of these effluents for irrigation.

References

APHA, 1998. Standard methods for the examination of water and waste water (18th edu) American Public Health Association , Washington D.C

Bhutiani R., and Ahamad Faheem 2018. Efficiency assessment of Sand Intermittent Filtration Technology for waste water Treatment. ***International Journal of advance research in science and engineering (IJARSE),*** 7(03): 503-512.

Bhutiani, R., Khanna,D.R., Shubham and Ahamad Faheem, 2016. Physico-chemical analysis of Sewage water treatment plant at Jagjeetpur, Haridwar, Uttarakhand. ***Environ. Cons. Jour.,***17(3):133-142.

Bhutiani,R., Pratap Hari, Ahamad Faheem, Kumar Paritosh, Kaushik Pankaj Dutt, 2017. Efficiency Assessment of Effluent Treatment Plant (ETP) Treating an Automobile Industry Effluent (Sidcul) Haridwar. ***Environment Conservation Journal*** 18 (1&2):95-102.

Bhutiani R., Khanna D.R., Tyagi Varun, Ahamad Faheem, 2015.Removal of turbidity in dairy waste water through aquatic macrophytes, ***International Journal of Research – GRANTHAALAYAH.*** 9(3):1-3.

Czabator, F.J, 1962. Germination value: An index combining speed and completeness of pine seed germination. ***For. Sci.*** 8, 386-395.

Khanna,D.R., and Bhutiani, R., 2008. Laboratory manual of water and Waste water Analysis. ***Daya Publishing House*** New Delhi -110002.

Khanna, D.R., Bhutiani R. Tyagi Varun and Ahamad Faheem, 2014. Impact of Sugar Mill Effluent on Physico-chemical Properties of Malin River at Najibabad, Bijnore***. Indian. J. Sci. Res.Spl. Ed & NSESIR,*** :5-10.

Dutta, S.K. and Boissya, C.L., 1996. Effect of paper effluent on germination of rice seed and growth behaviour of its seedlings . ***Journal of Industrial Pollution Control,*** 13 (1): 41-47.

Karande, S.M., Ghanvat N.A. and Gunjal P.S., 1993. Influence of untreated effuents at Pravara pulp and paper mill and Pravara distillery on seed germination and early seeding growth in Jowar and Bajra. 2(1): 5-10.

Kaushik, P.V.K Garg and Singh, B., 2005. Effect of textile effluents on growth performance of wheat cultivars . Bioresource Technology, 6:1189-1193.

Mishra, K. and Sahoo S., 1989. Sgro Potentially of paper mill waste water. Soil pollution and soil organisms (Ed) P.C. Mishra , Ashish Publishing House , New Delhi.

Mishra, R.N. and Behera P.K., 1991. The effect of paper industry effluent on growth, pigments, carbohydrates and proteins of rice seedlings. ***Environment Pollution***, 72(2):159-167.

Rajannan, G. and Oblisami, 1979. Effect of paper factory effluent on soil and crop plants. ***Indian Journal of Environment Health,*** 1(2):120-130.

Rao, J.V.S., M.R.K. Rama and Samba, M.S., 1979. Allelopathic effect of some weed of vegetable crops on the germination and early seedling growth of bajra. ***Tropical Ecol.,*** 20:5-8

Rivard, P.G. and Woodland P.M., 1989. Light, ash and pH effects on the germination and seedling growth of *Typha. J. **Bot***. 67:2783-2787.

Shahidruhiana, 1995. Effect of polluted paper mill effluent on the seed germination and seedling growth of *Vigna mungo CVP-390*. ***Advances in Plant Sciences,*** 8(1):120-125.

Sowmeyan, R., 2002. New Technology for waste water treatment in Industries. Industry and Environment (Ed.) R.K. Trivedy. Daya Publishing House: 119-123.

Sundaramoorthy, P., and Kunjithapatham, J., 2000. Effect of paper effluent on seed germination and seedling growth of six varieties of groundnut (*Arachis hypogea*). ***J. Excotoxicol. Environ. Monit.*** 10:53-57.

Trivedy, P.K. and Goel, P.K., 1986. Chemical and Biological methods for water pollution studies. Environment Publication, Karad.

Trivedy, R.K., 2002. Industry and Enviornment (Daya Publishing House New Delhi :540

Veena, V., Sahu A.K. and Patel M,. 1992. Paper mill sewage in agricultural soil amendment and effluent water for irrigation. ***IPPTA*** 4 (1):112-121.