Original Research Article

Textile effluents affected seed germination and early growth of some winter season crops (Wheat and Mustard): A case study

Abstract

The use of textile effluent water for irrigation purposes has emerged an important way to utilize its nutrients and removal of its pollutants load by growing tolerant plant species. An investigation was made to study the degree of toxicity of textile effluent waste water on seed germination percent and early growth of wheat and mustard. Physico-chemical parameters of textile effluent such as pH, Electrical Conductivity, Total Dissolved Solids, Total hardness, Chloride, Sulphate, Calcium, Sodium, and Magnesium were analyzed of which electrical conductivity, total dissolved solids, sulphate were relatively high. Germination experiments were carried out in sterilized petri dishes containing 0%, 25%, 50 & and 75% concentrations of textile effluent. The germination percentage, growth parameters like plumule and radicle length. There was a gradual decrease in the percentage of seed germination and seedling growth with higher concentration of effluent. Relative toxicity and percentage of phytotoxicity was maximum at 75%. Growth parameter such as plumule and radicle length of seedlings were minimum at 75% and maximum at 25% of effluent concentration.

Keywords: Textile waste water, seed germination, wheat and mustard.

Introduction

Water is one of the most important precious resources found on the earth. The water resources are most often affected by anthropogenic activities and also from industries. Growth of population, massive urbanization, rapid rate of industrialization and modern techniques in agriculture have accelerated the water pollution and led to gradual deterioration of its quality Prabhakar *et al.* (2004), APHA (1998). Textile industries have been placed in the category of most polluting industries by the Ministry of Environment and Forests, Government of India. India has a large network of textile industries of varying capacity that are distributed throughout the country. Textile city (Bhilwara district) has maximum textile industries in Rajasthan of India. The textile effluent contains organic and inorganic chemical species have adverse effect on growth of all plants and animals, because textile effluent used for irrigation contains heavy metals (Ni, Cd, Cr, Pb, Hg etc.), which accumulate in various parts of plants that result in various clinical problems in animals as well as in human beings including hepatic and renal system damages, mental retardation and degradation of basal ganglia of brain and liver (Misra and Dinesh 199). Effluent in higher concentration affect the soil and causes heavy damage to the crop growth conditions. The use of such waste water in irrigation system definitely provides some nutrients to enhance the fertility of soil but it also deposits toxicants that change soil properties in

the long run. The low amount of O_2 in dissolved form due to the presence of high concentration of solid in the effluent reduces the energy supply through anaerobic respiration resulting in restriction of growth of seedlings (Saxena *et al.* 1986). The improper and indiscriminate disposal of textile effluents in natural waters and land in posing serious problems (Kaushik *et al.* 2004). The exposure of lower concentration of effluent to the seedling shows growth promotion, over all development of the seedling. Reduction in seed germination percentage at higher concentration of effluent may be due to the higher amounts of solids presents in the effluent, which causes changes in osmotic relationship of the seed and water (Prabhakar *et al.* 2006). In the present study an attempt was made to analyze the impact of effluent water, collected from different industries at Chittorgarh By-Pass road, Bhilwara (Raj.).

Materials and Methods.

a. Collection of Textile effluents-

The Industrial effluent waste water collected from discharge points of recycle waste water tank and the respective sources. Sample of textile effluent water was collected from the 50 liter drum of textile industries in Bhilwara.

b. Seed collection-

The effect of textile effluent has been studied on two different crop wheat (*Triticum aestivum* L.) *viz.* Raj-.4079 and Mustard (*Brassica juncea* L.) *viz.* SM-21. The seeds were procured from the certified local seed supplier. Seeds were surface sterilized with 0.1% $HgCl_2$ and thoroughly rinsed with distilled water for 10 minutes to avoid fungal contamination before plating.

c. Experimental Design-

Sterilized Petri plates prepared with whatman filter paper and known volume of different concentration of textile effluent (0%, 25%, 50% and 75%) was poured into different petri plates marked with the concentration. Twenty five seeds were placed especially in sterilized Petri plate. The effluent (50ml) was irrigated periodically at every 24 hours.

d. Germination of wheat and mustard-

Number of seeds responded for germination percent, plumule and radicle length of the seedlings were observed on second, fourth and eighth day's incubator with 12h of light illumination per day.

1. The seeds of wheat and mustard were surface sterilized with 0.1% of $HgCl_2$ for 2-3 minutes, washed in running tap water for 3 minutes and in distilled water for 2 minutes.
2. 25 seeds of each wheat and mustard were placed in sterilized glass petri plate of size 15 X 100 mm lined with two Whatman filter paper discs.
3. The Whatman filter papers were wetted with 5ml of Fresh water (control) and same (5ml) of various concentration of textile effluent.
4. After seed inoculation the plates were incubated at room temperature, in the laboratory.

5. The preparation was moistened with 5ml of effluent every 12 hours and observed for radicle emergence. Triplicates were maintained, the results were averaged.
6. Germination percentage, relative radicle length and plumule length were determined.

- **Germination percentage-** The formula given by Rehman *et al.* (1998) was used to estimate germination percentage.
  Formula of germination percentage = Number of seed germination /Total number of seed x 100
- **Radicle and Plumule length-** Length of radicle and plumule of seedlings were calculated by using the standard centimeter scale.

e. Study Area

The textile effluents treated waste water with mixed surface irrigation water (e.g. pond), textile waste water (TWW) and control (Fresh water). The wheat and mustard seeds were allowed to germinate various concentrations of water. The physico-chemical properties of the effluent were analyzed by the procedure of APHA (1992) in the Soil science and agricultural chemistry laboratory, School of Agriculture Science and Technology, Sangam University, Bhilwara, Raj. Analytical results of different parameters and effect of textile effluents have been discussed:

Table -1 Physico-chemical parameters of Textile effluent water

S.N.	Parameter	Treated waste water	Surface /irrigation water
1.	pH	8.15	7.90
2.	EC (mmho cm-1)	3.30	0.98
3.	TDS	4200	605
4.	Hardness ppm	91	55
5.	Calcium (mg/l)	41	20
6.	Magnesium (mg/l)	50	35
7.	Sodium (mg/l)	200	80
8.	Sulphate (mg/l)	101	45
9.	Chloride (mg/l)	250	42

***Note- Treatment Level**

1. T_1- Control (100% Fresh water)
2. T2- Effluent: Fresh water (25% + 75%)
3. T3- Effluent: Fresh water (50% + 50%)
4. T4- Effluent: Fresh water (75% + 25%)

RESULTS AND DISCUSSION

The result of various physiochemical characteristic of common effluent of textile industry is given in **Table-1.** The analysis of variance for the Completely Randomized Design,

accommodating wheat and mustard accessions, was done for seed germination, radicle length and plumule length. The analysis of variance revealed that mean squares due to treatments were highly significant.

The experiment on wheat (*Triticum aestivum* L.) and mustard (*Brassica juncea* L.) showed an inhibitory effect of textile industrial effluents on seed germination and its early growth as compared with control (**Table-2**). The wheat and mustard seeds irrigated with textile wastewater seed germination effect on showed in 2, 4 and 8 days interval. Seed germination and measurement with radicle length & plumule length in centimeter.

The result in Petri dish culture experiment are shown in **Table-2**. Seed of two crop varieties were grown in different dilutions of the textile effluent for the germination percentage, plumule length and radicle length. Rodosevich *et al.* (1997) considered seed germination a critical step as it reproduction and control the dynamics of plant population as well as probable crop productivity. The laboratory experiment of wheat and mustard showed inhibitory effect of industrial effluent on seed germination and its growth as compared with control.

In wheat, maximum seed germination percentage V_1T_1 (94.33%, 94.67% and 96%) whereas minimum seed germination percentage V_1T_4 (51%, 64% and 70%) which were recorded after 2, 4 and 8 days, respectively. As well as that in mustard maximum seed germination percentage V_1T_1 (79.33%, 87% and 89%) whereas minimum seed germination percentage V_1T_4 (48%, 60% and 64.33%) which were recorded after 2, 4 and 8 days, respectively.

Both crop were highly sensitive to the textile effluents water. **Table-2** shows the effect of effluent on radicle length and plumule length which showed a decreasing trend with the increase in effluent concentration. A similar trend was also observed in case of number of stipules. Plumule and radical length were significantly increased compared to Fresh water control. All the growth parameters increased at 25% effluent concentration and decreased at 50% and 75% effluent concentration. At 100% effluent concentration nutrients were raised too high to become toxic resulting in retarded root and shoot length (Dutta and Boissya, 1996). Mohammad and Khan (1985) also found no adverse effect of textile industry effluent at lower concentrations (<50% effluent concentration), which is in conformity with the present results (effective concentration 25% effluent). Similar observations were also noticed by Malaviya and Sharma (2011). It can be concluded from the present study that textile effluent as such inhibits the radicle length and plumule length whereas with dilution it promotes the germination and growth parameters of wheat and mustard. This could be related to the fact that some of the nutrients present in the effluent are essential but in higher concentration they become hazardous and toxic to the soybean plant (Ravi *et al.* 2014). The exposure of lower concentration of effluent to the seedling shows growth promotion, over all development of the seedling and chlorophyll content. Reduction in seed germination percentage at higher concentration of effluent may be due to the higher amount of solids presents in the effluent, which causes in the osmotic relationship of the seed and water. Hussain *et al.* (2013) also reported that diluted effluent (25%) increase the growth parameters and pigments in the Maize seedlings.

Conclusion

The compatibility of the effluents of textile industry located in Bhilwara, Raj., India for wheat and mustard growth was investigated during *Rabi* season. The results showed the growth parameters like percentage germination of seeds, plumule length and radical length of seed textile industry effluents led to healthy growth of wheat and mustard at 25% of dilution. The effluents had potential to be utilized as at dilution from of textile industry. 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. However, such recommendation needs some more extensive work to minimize the risk.

Table-2. Effect of textile effluents on some growth parameters of after two, four and eight days of test on *Rabi* Crops (Wheat and Mustard).

Source	Effect after two days of test			Effect after four days of test			Effect after eight days of test		
	SG%	PL	RL	SG%	PL	RL	SG%	PL	RL
V_1	80.50a	0.48a	1.16a	85.58a	1.27b	2.15a	88.08 a	2.93 a	3.16a
V_2	66.41b	0.46b	1.22a	79.91b	1.52a	1.52b	83.08 b	2.22 b	2.10b
SEm	0.482	0.004	0.024	0.328	0.033	0.035	0.27	0.039	0.048
SEd	0.682	0.005	0.033	0.464	0.046	0.05	0.382	0.055	0.067
CV	2.27	2.866	6.900	1.373	8.118	6.650	1.092	5.250	6.259
T_1	85.67a	0.50b	1.42a	91.33a	1.85a	2.58a	93.83a	3.55a	3.27a
T_2	83.67a	0.51a	1.45a	90.66a	1.58b	1.87b	92.17b	3.03b	2.75b
T_3	75.00b	0.46c	0.87c	87.00b	1.43c	1.90b	89.00c	2.65c	2.80b
T_4	49.50c	0.40d	1.01b	62.00c	0.73d	1.017c	67.33d	1.08c	1.70c
SEm	0.682	0.005	0.033	0.464	0.046	0.05	0.382	0.055	0.067
SEd	0.965	0.008	0.047	0.656	0.066	0.071	0.54	0.078	0.095
CV	2.274	2.866	6.899	1.373	8.118	6.650	1.093	5.250	6.259
V_1:T_1	88.00b	0.50ab	1.36b	94.33a	1.30c	2.17c	95.33a	3.56ab	3.03c
V_1:T_2	94.33a	0.52a	1.47ab	94.67a	1.53b	2.80a	96.00a	3.80a	3.47b
V_1:T_3	88.66b	0.50ab	0.85d	89.33b	1.57b	2.57b	90.66b	3.40bc	3.93a
V_1:T_4	51.00e	0.40c	0.95cd	64.00e	0.70d	1.10ef	70.33e	0.96f	2.20d
V_2:T_1	77.00c	0.49b	1.37b	87.00c	2.40a	2.37bc	89.00c	2.50d	2.03d
V_2:T_2	79.33c	0.51ab	1.53a	88.00bc	1.63b	1.57d	91.66b	3.30c	3.50b
V_2:T_3	61.33d	0.42c	0.90d	84.66d	1.30c	1.23e	87.33d	1.90e	1.67e
V_2:T_4	48.00f	0.40c	1.07c	60.00f	0.77d	0.93f	64.33f	1.20f	1.20f
SEm	0.965	0.011	0.047	0.656	0.066	0.071	0.54	0.078	0.095
SEd	1.364	0.008	0.067	0.928	0.093	0.1	0.764	0.111	0.134
CV	2.275	2.866	6.899	1.373	8.118	6.650	1.093	5.250	6.259
CD	1.446	0.023	0.071	1.967	0.139	0.149	1.619	0.234	0.284

* Means not sharing a letter in common differ significantly at 5% level of significance.

Note- SG%=Seed Germination percentage, PL=Plumule Length, RL=Radicle Length, V_1=Wheat, V_2=Mustard, T_1=Control (100% Fresh water), T_2- Effluent: Fresh water (25% + 75%), T_3- Effluent: Fresh water (50% + 50%), T_4- Effluent: Fresh water (75% + 25%)

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