HortFlora Research Spectrum, 3(1): 100-102 (March 2014) ISSN : 2250-2823

Research Note :

IMPACT OF MUNICIPAL AND INDUSTRIAL WASTE WATER ON CORN (*Zea mays L.*) CULTIVARS

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ABSTRACT : The impact of municipal and industrial waste water was studied on seed germination and seedling growth of different corn cultivars (viz. 31Y45,Shakti-1 and Siddhi). The experiment was formulated with four treatments (i.e. 25%, 50%, 75% and 100%) of waste water with three replicates each. Tap water was taken as control.The seed germination and seedling growth were inhibited in treated sets and this inhibitory effect increases with increased in the concentration of treatment. At lower concentration i.e. at 25% of wastewater, however, some promotion in seedling was recorded. Cultivar specific and organ specific differences often exists. Thus, waste water after proper dilution may be used for irrigation of crops.

Keywords : *Corn, municipal waste water, industrial waste water, seed germination, seedling growth.*

Today, India is one of the first ten industrialized countries of the world. We have a good industrial infrastructure in core industries-like textile, steel, metal, chemicals, fertilizers, petroleum, food, agricultural insecticides, pesticides, paper, detergents, paints and pharmaceuticals. From these industries, a number of toxic effluents and emissions are released in the atmosphere. All these industrial effluents are dumped into the water, thereby polluting it. The problem is further compounded because of the population burst in India and water is used in bathing, clothes washing, flushing away the human waste and cooling etc. All these activities add some pollutants to the water. In fact for centuries, rivers and lakes have been used as dumping grounds for human sewage and industrial waste of every conceivable kind; many of them are highly toxic. Water pollution problem in India has become acute due to discharge of waste water from various industries as well as domestic waste into the rivers without proper treatment.

Polluted water is responsible for environmental degradation and overstretching of ecosystems (Rana, 10). The effect of pollutants may be at the level of community or ecosystem (Bilgrami *et al.,* 1). Jabben and Saxena (3) stated that the industrial waste water can be used for irrigation after proper dilution. Irrigation with municipal and industrial wastes can bring plenty of changes in the chemistry of soil and affecting its fertility (Liangovon and Vivekanandan, 2). The waste water of different industries used for irrigation, seriously damage the seed germination and seedling growth of various crops but effects varies from crops to crop. Various researchers have carried out studies regarding the effects of different industrial effluents on crop plants (Ramana *et al.,* 9; Lal and Mishra, 4; Pandey *et al.,* 7 and 8; Nagjayothi *et al.,* 6; Malaviya and Sharma, 5).

Received : 08-01-2014 *Accepted : 03-02-2014*

The present study deals with the impact of different concentrations of municipal and industrial waste water on seed germination and seedling growth of different cultivars of corn in the laboratory conditions.

The present study was carried out by systematic collection of municipal and industrial waste water from a nullah flowing in Sardhana, a town 20km away from Meerut city. The samples were collected and stored in pre-cleaned plastic containers. The waste water was kept in refrigerator to avoid any change in characteristic and was used in further study when required.

The certified seeds of different cultivars of corn (*Zea mays* L.) viz. 31Y45, Shakti-1 and Siddhi were procured from Maize Department of IARI, New Delhi. These seeds were stored at standard conditions. Before performing the experiments, the per cent germination of these cultivars was checked and was found to be between 90 to 100%.

Petridish Experiment

For the germination experiment, certified, healthy and equal size seeds of maize (*Zea mays* L.) cultivars were sterilized with 0.1% $HgCl_2$ solution. After repeated washings with distilled water seeds were soaked in the water for 24 h ours. Then 10 sterilized seeds were arranged in petridishes, lined with double layer of filter paper. These were supplied/ treated with respective municipal and industrial waste water concentration and incubated at room temperature for germination. For the treatment 25%, 50%, 75% and 100% concentration of municipal and industrial waste water were prepared while tap water was taken as control. Triplets of each concentration were taken. Plates were labeled as per type and concentration of

municipal and industrial waste water. Germination was recorded daily at a fixed time and the emergence of the radicle was taken as a criterion for germination. The experiment was terminated after ten days. All the experiments were carried out in triplicate and the results were averaged. For seedling growth ten days old seedling were picked from each of the sets and length, fresh weight and dry weight of root and shoot were measured.

During present investigation, the effect of different concentrations (25%, 50%, 75%, and 100%) of municipal and industrial waste water (MAIWW) on seed germination and seedling growth of different corn cultivars (*Zea mays* L.) were recorded. The germination percentage decreased with increasing the concentrations of MAIWW in different corn cultivars. However, at lower concentration, it has no any significant inhibitory effect (Table 1)

Table 1 : Effect of different concentrations of municipal and industrial waste water on germination percentage of different corn cultivars.

Treatment	31Y45	Shakti-1	Siddhi
Control*	100 ± 0.00	98 ± 0.57	100 ± 0.00
25%	100 ± 0.00	93 ± 0.50	96 ± 1.00
50%	90 ± 0.33	82 ± 0.28	83 ± 0.31
75%	73 ± 1.00	70 ± 1.15	74 ± 0.57
100%	55 ± 2.89	65 ± 1.52	62 ± 1.85

* tap water; mean ± SD

In cv. 31Y45, germination percentage was recorded 100 per cent at control and 25% MAIWW, however, it was 90, 73 and 55 per cent at 50% 75% and 100% MAIWW, respectively. In cv. Shakti-1, germination percentage was observed to be 98 per cent at control and 93, 82, 70, and 65 per cent at 25%, 50%, 75% and 100% concentrations of MAIWW, respectively. In the same way in cv. Siddhi, it was recorded 100 per cent at control, and 96, 83, 74 and 62 per cent at 25%, 50%, 75% and 100% concentrations of MAIWW, respectively. These observations are in conformity with the findings of Ramana *et al.* (9), who reported inhibition of seed germination of different crops by distillery effluent. Similarly, Pandey *et al.* (7) also observed decrease in germination percentage with increase in concentration of distillery effluent in wheat, pea and lady's finger.

Root and shoot length in all corn cultivars were recorded to be decreased at 50%, 75% and 100% concentrations of MAIWW. However, these parameters increased slightly at 25% MAIWW (Table 2).

The root and shoot length showed 43.96 and 41.24 per cent reduction at 100% concentration of MAIWW in cv. 31Y45, whereas 55.01 and 33.07 per cent in cv. Shakti-1, and 52.83 and 37.53 per cent in cv. Siddhi, respectively. When we compared the root and shoot lengths of all the three cultivars tested, it was observed that root lengths were affected more than shoot lengths at higher concentrations of MAIWW. This may be due to the fact that roots are in direct contact of the municipal and industrial waste water. So in present study roots were found to be more sensitive than shoots.

Similarly, fresh weight and dry weight (Table 3) were observed to be increased slightly at 25% concentration of MAIWW and then showed a decreasing trend with increase in concentrations of MAIWW. The reduction in fresh and dry weight was recorded to be 49.54 and 40.96 per cent in cv. 31Y45, 47.90 and 40.87 per cent in cv. Shakti-1 and 44.08 and 33.59 per cent in cv. Siddhi, respectively, at 100% MAIWW.

From these results it can be concluded that the higher concentrations of MAIWW are inhibitory for seed germination and seedling growth of different maize/ corn cultivars. However, at lower concentration (25%) of MAIWW slight promotion in seedling growth was reported. Cultivar specific and organ specific

Table 2: Effect of different concentrations of municipal and industrial waste water on root and shoot length (cm) of different corn cultivars.

Treatment	31Y45		Shakti-1		Siddhi	
	RL	SL	RL	SL	RL	SL
Control*	8.78 ± 0.60	16.97 ±1.27	7.38 ± 0.19	14.39 ± 1.21	7.76 ± 0.72	15.08 ± 1.09
25%	9.37 ± 0.84	18.81 ±1.43	8.64 ± 0.67	16.79 ± 1.20	8.64 ± 0.67	17.59 ± 1.2
50%	6.95 ± 0.54	16.61 ± 1.28	5.95 ± 0.48	12.87 ± 1.19	5.50 ± 0.94	12.48 ± 1.25
75%	6.63 ± 0.33	12.32 ± 0.98	4.23 ± 0.90	11.50 ± 0.94	4.92 ± 0.78	10.37 ± 1.15
100%	4.92 ± 0.80	9.97 ± 0.52	3.32 ± 0.18	9.63 ± 0.33	3.66 ± 0.42	9.42 ± 0.93

*tap water, mean + SD, RL-Root length, SL-Shoot length.

Table 3: Effect of different concentrations of municipal and industrial waste water on fresh and dry weight (g) of different corn cultivars.

Treatment	31Y45		Shakti-1		Siddhi	
	F.Wt.	D.Wt.	F.Wt.	D.Wt.	F.Wt.	D.Wt.
Control*	1.312 ± 0.028	0.166 ±0.020	1.192 ± 0.018	0.115 ± 0.007	1.234 ± 0.020	0.128 ± 0.006
25%	1.367 ± 0.031	0.182 ±0.019	1.470 ± 0.035	0.125 ± 0.012	1.396 ± 0.023	0.143 ± 0.010
50%	0.948 ± 0.025	0.129 ± 0.014	0.987 ± 0.020	0.092 ± 0.010	0.965 ± 0.019	0.112 ± 0.011
75%	0.795 ± 0.018	0.114 ± 0.016	0.756 ± 0.023	0.077 ± 0.013	0.801 ± 0.011	0.103 ± 0.015
100%	0.662 ± 0.022	0.098 ± 0.011	0.621 ± 0.026	0.068 ± 0.010	0.690 ± 0.021	0.085 ± 0.012

*tap water, mean + SD, F.Wt.-Fresh weight, D.Wt.-Dry weight.

differences often existed. The results are in confirmation with the findings of Pandey *et al.* (8), who have reported the adverse impact of concentrated distillery effluents on rice and maize seed germination and seedling growth. Lal and Mishra (4) reported marked decrease in seed germination and seedling growth of *Vigna radiata* by higher concentrations of synthetic detergent.

The inhibition of seed germination and seedling growth by municipal and industrial waste water may be due to presence of toxic chemicals and heavy metals in it. However, slight promotion at lower concentration of it may be due to presence of certain mineral nutrients in it.

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Citation : Sarawat P. and Veer, B. (2014). Impact of municipal and industrial waste water on corn (*Zea mays* L.) cultivars. *HortFlora Res. Spectrum,* **3**(1). 100-102.