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Effect of Marble Industry Effluent on Seed Germination, Post Germinative Growth and Productivity of *Zea mays* L.

Fazal Akbar, Fazal Hadi, Zakir Ullah and Muhammad Amir Zia
Department of Biotechnology, University of Malakand, Chakdara, NWFP, Pakistan

Abstract: A green house study was conducted at the University of Malakand, NWFP, Pakistan to evaluate the effect of marble industry effluent on soil pH, germination, post germinative growth and productivity of maize. The experiment was conducted in triplicate form for each treatment and tape water was used as control (T_0). Effluents were diluted with tap water at concentration of 20% (T_1), 40% (T_2), 60% (T_3), 80% (T_4) and also used 100% (T_5) concentration in 4 kg soil pot^{-1} and plants were grown for 90 days. Results showed that there was a linear increase in pH of soil with increase in effluent concentration while germination, root length and stem girth was enhanced and found maximum at 40% concentration of effluent applied. The shoot length and root dry biomass was depressed as compared to control. It is concluded from the present study that marble industry effluent can be used as a fertilizer in low concentration especially for highly acidic soil but there is still need to carry out series of greenhouse and field trials to ascertain the fertilizer potentials of this effluent for maize crop.

Key words: Marble industry effluent, *Zea mays* L., post germinative growth, dry biomass

INTRODUCTION

Pakistan is one of the countries, which is being threatened by soil and water pollution by uncontrolled industrial effluents, household sewage, saline drainage water, dust and dirt etc. It has been reported that about 9000 million gallons of wastewater is being daily discharged into water bodies from industrial sector (Salaam *et al*., 1993). Tan *et al*. (1979) reported that different types of effluents have influenced the growth of various crops. Napier grass production has been observed to increase significantly with rubber effluent application while tannery effluent caused an increase in leaf area, biomass, chlorophyll content and total protein of *Gossypium hirstum*, *Vigna mungo*, *Vigna unguiculata* and *Lycopersicum esculentus* over control as observed by Karunyal *et al*. (1993). Rajni and Chanchan (1996) using tannery effluent and Dutta and Biossaya (1997) using paper mill effluent, however, observed a significantly reduction in germination percentage, root length and total biomass in almost all varieties of *Hordeum vulgare* and *Oryza sativa*, respectively. Nawaz *et al*. (2006) performed a study to determine the effects of different effluents of different industries of Rawalpindi which were Koh-e-Noor textile Mill (KNM), Marble Industry (MI) and Attock Refinery Limited (ARL) on seed germination and early growth of plants. Two different varieties of *Cicer arientum* (P-91 and P-2000) were selected to grow in these effluents. Both varieties were grown in different dilutions of effluents. With the increase in effluent concentration, growth of plants was found more effected in Koh-e-Noor mill effluent; less effect was seen in Marble effluent and ARL effluents. Increase in root and shoot lengths was observed in these effluents at different concentrations. Fresh weight was less in Koh-e-Noor mill effluent as compared to control while in other two effluents both increases and decreases in dry weight were observed. Dry weights of plants were greater in most of the treatments. Variety P-91 was more tolerant as compared to P-2000. Objective of the present study was to monitor the effect of marble industry effluent at different concentrations on the pH of soil, germination of seeds, growth and yield of maize crop.

MATERIALS AND METHODS

Effluents were collected from Alkarim Marble Industry at Chakdara, Dir (L) and were diluted with tap water at concentration of 20% (T_1), 40% (T_2), 60% (T_3), 80% (T_4) and also used 100% (T_5) concentration, tape water was used as control. Plastic pots were filled with 4 kg of soil, dung and sand mixture in the ratio of 2:1:1. Seeds of *Zea mays* (Cultivar-974AW hybrid) were obtained from Agriculture research center Mingora. Seeds were surface sterilized by immersion in 70% ethyl alcohol for two minutes and 0.1% mercuric chloride for

Corresponding Author: Fazal Hadi, Department of Biotechnology, University of Malakand, Chakdara, NWFP, Pakistan
Tel: 03349308644

5 min (Ekrum, 2001). Ten seeds were sown in each pot in month of September 2006. After germination, three uniform seedlings were selected in each pot and three pots were used for each treatment. The effects of effluent on soil pH, seed germination, height of plant (cm), stem girth (cm), number of leaves, root length (cm) and root as well as shoot dry biomass (g) were investigated. Shoot length of the plants was measured from base to apical leaf of the plant, after harvesting roots were washed with tap water and then root length was measured with ruler in cm, the roots and shoots were kept in oven at 72°C for 72 h and then dry biomasses of roots and shoots were measured by electrical balance.

Statistical analysis: Mean, standard error of mean, Standard Deviation and Coefficient of Variance were found out using Graph Pad Prism. ANOVA values were calculated for all the parameters using SPSS.

RESULTS

Mean values and Analysis of variance (ANOVA) for the effect of marble industry effluents at different concentrations on pH of soil, seed germination and pant height are presented in Table 1 and significant differences were observed among the treatments. The maximum pH value (8.4) was found at 100% concentration as compared to control. Maximum germination was found at 40% effluent concentration while then a declined occurs and minimum germination was observed at 100% concentration of effluent applied. Decrease in plant height/shoot length at harvest was found with the increase of concentration of marble industry effluent. The minimum height was found at 100% effluent as compared to control.

Mean values and ANOVA for the effect of marble industry effluent on stem girth, number of leaves and root length are presented in Table 2 and significant results were observed for stem girth. The maximum stem girth was found at 40% concentration while 100% concentration showed the minimum value. There was no significant difference found in number of leaves and root length among different treatments while the maximum number of leaves was found for 60% concentration and the minimum at 100% concentration while root length was found maximum at 40% concentration a compared to control.

Table 3 shows that significant difference was found among different treatments for root dry biomass. The maximum root dry biomass value was found at control followed by 100% while the minimum at 80%. There was no significant difference found among different treatments for shoot dry biomass while maximum shoot dry biomass value was found at 40% concentration as compared to control.

Table 1: The effect of effluent on soil pH, seed germination and plant height

	Effect on soil (pH)				Effect on seed germination (%)				Plant height (cm)			
Treatments	Mean value	±SEM	Std dev.	Co. of varia.	Mean value	±SEM	Std dev.	Co. of varia.	Mean value	±SEM	Std dev.	Co. of varia.
Control	7.88	0.14	0.24	3.13	8.66	0.33	0.57	6.6	155.1	4.61	13.8	8.92
T1	7.98	0.07	0.12	1.55	8.66	0.66	1.15	13.3	148.9	5.01	15.0	10.09
T2	8.25	0.04	0.08	0.99	9.00	1.00	1.73	19.3	142.7	6.22	18.7	13.09
T3	8.37	0.05	0.08	1.06	7.66	2.33	4.04	52.7	142.0	9.19	27.6	19.42
T4	8.40	0.07	0.12	1.48	7.00	0.57	1.00	14.3	141.9	3.66	11.0	7.75
T5	8.40	0.07	0.12	1.52	4.66	1.66	2.88	61.9	118.2	2.60	7.82	6.62
F-value	10.311				3.737				04.820			
p-value	0.001				0.037				00.001			

$p<0.05$ = Insignificant, $p<0.05$ = Significant, Std dev = Standard deviation, Co. of Varia = Coefficient of variance

Table 2: The effect of effluent on stem girth, number of leaves and root length

	Effect on soil (pH)				Effect on seed germination (%)				Plant height (cm)			
Treatments	Mean value	±SEM	Std dev.	Co. of varia.	Mean value	±SEM	Std dev.	Co. of varia.	Mean value	±SEM	Std dev.	Co. of varia.
Control	5.22	0.25	0.75	14.42	11.89	0.26	0.78	6.58	31.06	1.94	5.83	18.78
T1	4.50	0.14	0.42	9.49	11.33	0.33	1.00	8.82	31.67	1.04	3.12	9.86
T2	5.34	0.21	0.65	12.24	11.67	0.50	1.50	12.86	38.56	3.52	10.56	27.39
T3	4.98	0.27	0.83	16.72	12.00	0.33	1.00	8.33	35.22	1.43	4.29	12.19
T4	4.24	0.15	0.45	10.74	11.78	0.22	0.66	5.66	33.33	2.38	7.15	21.48
T5	4.16	0.09	0.29	7.10	11.00	0.16	0.50	4.55	33.33	2.64	7.93	23.81
F-value	6.535				01.396				01.937			
p-value	0.000				00.244				00.112			

$p>0.05$ = Insignificant, $p<0.05$ = Insignificant, Std dev = Standard deviation, Co. of varia = Coefficient of variance

Table 3: The effect of effluent on shoot and root dry biomass

	Shoot dry biomass (g)				Root dry biomass (g)			
Treatments	Mean value	±SEM	Std dev.	Co. of varia.	Mean value	±SEM	Std dev.	Co. of varia.
Control	95.94	6.91	20.75	21.63	21.56	1.51	4.55	21.15
T_1	78.33	10.22	30.67	39.16	9.88	1.00	3.01	30.52
T_2	104.4	15.35	46.06	44.10	12.22	1.12	3.38	27.68
T_3	75.78	19.05	57.16	75.43	13.78	1.03	3.11	22.60
T_4	74.22	9.51	28.53	38.44	10.89	1.20	3.62	33.25
T_5	60.22	8.28	24.86	41.28	19.11	2.47	7.42	38.84
F-value	01.826				7.703			
p-value	00.126				0.000			

$p>0.05$ = Insignificant, $p<0.05$ = Significant, Std dev = Standard deviation, Co. of Varia = Coefficient of variance

DISCUSSION

Many studies have been conducted regarding the treatment of industrial effluents (Habib, 1995). Effluents contain heavy metals and also nutrients, (Rodrigues *et al*., 1996; Dhevagi and Oblasami, 2002) which effect plants and soils in a variety of ways. Industries are developing rapidly in Pakistan and in many cases the effluents from the industries are disposed off untreated either in the soil or in water. Such contaminated water is used for many human activities, agriculture being one of them. Present study was designed to see the effect of marble industry effluents on the growth and development of maize. A similar study has been conducted by Orhue *et al.* (2005) where they studied the effect of brewery effluents on growth of maize crop. For present work. Industrial effluents were collected from the main drain (Nullah) of Alkarim Marble Industry Chakdara. In precise study, marble industry effluent showed an increase in soil pH as recorded by Nawaz *et al.* (2006). This increase in pH may be attributed to high calcium content of the marble effluent. The results from Dhevagi and Obligami (2000), Sharma *et al*. (2002) strongly correlate with the present work while Nawaz *et al.* (2006) reported 100% germination at all concentrations except 100% effluent concentration where germination was 93.750% these results however, not correlate with the results obtained in the present work. This variation might be due to the difference in species because they used *Cicer arientum* (variety P-91) in their experiment. The present study shows an increase in stem girth at low concentration of effluent applied while decreased as the effluent concentration rise above 40%. Karpate and Choudry (1997) used fly ash effluent on *Triticum aestivum* and Ammar *et al.* (1999) used other industrial effluents also found the same result that industrial effluents had a positive effect on plant stem girth at low concentration. The reduction at higher concentration may be due to accumulation of heavy metals at toxic level. There were no significant differences recorded among treatments in number of leaves (Orhue *et al*., 2005). Rao and Kumar (1983) observed a decline in root length in *Cicer arientum* due to tannery effluents. Chromium, a principal constituent of tanneries is known to inhibit soil microorganisms such as nitrifying bacteria that in turn affect the root length of plants (Fargo and Flemming, 1977). Rajni and Chanchan (1996) using tannery effluent and Dutta and Biossya (1997) using paper mill effluent observed a significant reduction in root dry biomass in almost all varieties of *Hordeum vulgare* and *Oryza sativa*, respectively which strongly co-relates with the present study. Mishra and Kar (1974), Brekle (1991) and Srivastava and Sanhai (1996) using tannery effluent in almost all varieties observed similar result to the present work that low concentration of effluent was effective for shoot dry biomass.

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