J. Biol. Chem. Chron. 2017, *3(1)*, 01-04
ISSN (Print): 2454 – 7468
ISSN (Online): 2454 - 7476
www.eresearchco/jbcc/

Effect of Chlor-alkali Effluent on Root and Shoot Length of Seedlings of Some Plants

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(Received 07 Jan, 2017; Accepted 18 Jan, 2017; Published 24 Jan, 2017)

ABSTRACT: Impact of Chlor-alkali effluent (CAE) was analysed on Barbati *(Vigna sinensis)*, Methie *(Trigonella foinumgraecum)*, Tomato *(Lycopersicum esculentum)*, Soyabean *(Glycine max)*, Mustard *(Brassica nigra) and* Onion (*Allium cepa)*. Parameters selected were root length and shoot length of seedlings. Effect of chlor-alkali effluent was analyzed at different dilutions viz. 10%, 20%, 40%, 60%, 80%, 100% and control. At 10% effluent concentration, mean length of seedlings of Vigna sinensis, Brassica nigra, Lycopersicum esculentum, Glycine max and Trigonella foinumgraecum was increased whereas mean length of seedling of Allium cepa decreased when compared with control condition. At 20% effluent concentration, mean length of Trigonella foinumgraecum and Brassica nigra were promotory when compared with their controlled condition. In case of Vigna sinensis, Allium cepa and Glycine max, mean length of seedlings was inhibited but there was no effect on mean length of Lycopersicum esculentum in respect with controlled condition seedlings. At 20% to 100% effluent concentration, the mean length of seedlings of all species was inhibitory when compared with mean length of seedlings of control conditions.

Keywords: *Chlor-alkali effluent; Vigna sinensis; Trigonella foinumgraecum; Lycopersicum esculentum; Glycine max; Brassica nigra and Allium cepa.*

INTRODUCTION: Man has been disturbing the nature since the starting of human civilization. The rapid increase in population followed by increased demand from industrial establishment to meet human requirement have created hazardous problems such as over exploitation of natural resources and pollution of land, air and water.

Pollution refers to undesirable changes in the physical, chemical or biological characteristics of our environment namely, air, water and soil. This has adversely affected the humans and other species of our biosphere directly or indirectly. Industries play a major role in polluting the environment. Effluents from industries are normally considered as the main industrial pollutants containing organic and inorganic compounds. The disposal of these industrial effluents is a major problem throughout the world.

In India, a huge amount of waste water generated from chlor-alkali paper-mill and distillery industries is discharged on land or in running water. Chlor-alkali effluent is characterized by high pH, high BOD and COD values and contains high percentage of organic and inorganic materials. Besides these materials, effluents contain elements like Co, Ni, Zn and high amounts of Hg. Disposal of these effluents is a problem of major concern today. Nowadays, at most of the places these industrial effluents are used for irrigation purposes after some treatment. There are two main objectives of using effluents for irrigating crop plants. The first and foremost of this is safe disposal of effluents, which may otherwise have adverse effects on the environment and human health. The other objective is to recycle it as irrigation water, as compost for its possible fertilizer value. Generally, the quality of discharged effluent varies from industry to industry which may or may not be suitable for the irrigation of crop. So, the effluent should be treated properly prior to its application for irrigation. However, indiscriminate use of industrial effluents may reduce crop growth and contaminants may interfere with natural characteristics of soil. Not only the soil chemistry is or vegetation is affected but the toxic pollutants affect aquatic system as well as there are health impacts of effluent such as diarrhoea, vomiting, headache, nausea, eye irritation on human beings.

Though lower concentration of effluents may act as fertilizers for crops yet at higher concentrations, effluents have toxic effects on vegetable plants and crops. Rengini and janardhanan (1989) studied the effect of polluted water on the length of S. indicum var, co-1 and S. indicum var, T. M. v-4. On the basis of above study this experiment of root and shoot length of seedlings was carried out.

The seeds of the following six species Barbati *(Vigna sinensis)*, Methie *(Trigonella foinumgraecum)*, Tomato *(Lycopersicum esculentum)* and Soyabean *(Glycine max)* were taken up for study.

MATERIAL AND METHODS: Healthy seeds of Soyabean, Tomato, Methie, Onion, Mustard and Barbati were soaked separately in the Chlor-alkali effluent solution (10, 20, 40, 60, 80 and 100%), along with the control for the whole night.

20 ml of each solution mentioned above were used to soak the filter paper in the neat and clean petridish. Triplicate sets of petridish for each solution were prepared. The seeds were spread at the rate of 20 per petridish, 60 seeds of each species were tested for each concentration. Control germination was also run simultaneously. From the second day of sowing of the seeds, the germination was studied and carried out for five days. Total length of mean root and shoot length of seedling are given in Tables 1, 2 & 3.

RESULTS AND DISCUSSION: At 10% effluent concentration the mean length of the seedlings of *Vigna sinensis, Brassica nigra, Lycopersicum esculentum, Glycine max,* and *Trigonella foinumgraecum* were increased, whereas the mean length of seedlings of *Allium cepa* decreased when compared with control condition of the seedlings. Barua (1986) saw very similar effects when he treated gram seeds by polluted water (Mercury, Lead and Cadmium).

At 20% effluent concentration the mean length of seedlings of *Trigonella foinumgraecum* and *Brassica nigra* were promotary when they were compared with control condition of the seedlings. In case of *Vigna sinensis, Allium cepa* and *Glycine max,* the mean length of the seedlings were inhibited but there was no effect on mean length of seedlings of *Lycopercicum esculentum* in respect with control conditions seedlings. Malhotra (1931) also noted similar slight stimulation in the growth of the corn seedlings treated with Iodine solution. At 20% to 100% effluent concentration the mean length of the seedlings of the all species were inhibitory when they were compared with the mean length of the seedlings of control conditions. Similar toxic effects were observed by Nag et al. (1984), Mathur, K.C. and Chaudhary Kanchan (1984) and Rengini and Janardhanan (1989).

Table 1: Average length (cm) of seedlings.

% of chlor-alkali effluent	G.M.	V.S.	L.E.	A.C.	T.F.	B.N.
10	12.66	12.94	6.34	3.29	7.24	7.74
20	12.10	12.32	6.29	3.18	6.82	7.60
40	11.80	11.70	5.86	2.72	6.18	6.50
60	11.34	10.54	5.60	2.35	5.86	5.98
80	10.30	09.58	5.01	1.98	5.44	5.50
100	09.34	07.92	4.38	1.69	4.44	4.27
Control	12.57	12.80	6.29	3.42	6.74	7.58

Table 2: Average root and shoot length (cm) of seedlings.

% of chlor -alkali effluent	*Glycine max*		*Vigna sinensis*		*Lycopersicum esculentum*		*Allium cepa*		*Trigonella foinumgraecum*		*Brassica nigra*	
	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot	Root	Shoot
10	4.32	8.34	4.32	8.62	3.08	3.26	0.89	2.40	2.42	4.82	2.62	5.12
20	4.06	8.04	3.96	8.36	3.08	3.26	0.92	2.26	2.22	4.60	2.56	5.04
40	3.88	7.92	3.72	7.98	2.86	3.00	0.76	1.76	2.06	4.12	2.08	4.42
60	3.54	7.80	3.12	7.42	2.68	2.92	0.63	1.72	1.94	3.92	1.96	4.02
80	3.12	7.18	2.82	6.76	2.43	2.58	0.48	1.50	1.74	3.70	1.68	3.82
100	2.82	6.52	2.12	5.80	2.06	2.32	0.33	1.36	1.32	3.12	1.14	3.13
Control	4.28	8.29	4.26	8.54	3.06	3.23	0.94	2.48	2.20	4.54	2.54	5.04
	-.99	-.98	-.99	-.98	-.98	-.98	-.99	-.99	-.98	.98	.98	.98

Table 3: Regression value of root and shoot length (cm).

% of chlor - alkali effluent	*Glycine max*		*Vigna sinensis*		*Lycopersicum esculentum*		*Allium cepa*		*Trigonella foinumgraecum*		*Brassica nigra*	
	Root	**Shoot**	**Root**	**Shoot**	**Root**	**Shoot**	**Root**	**Shoot**	**Root**	**Shoot**	**Root**	**Shoot**
10	4.29	8.38	4.30	8.74	3.16	3.30	0.96	2.32	2.37	4.75	2.67	5.13
20	4.13	8.20	4.07	8.44	3.05	3.20	0.89	2.21	2.27	4.58	2.51	5.92
40	3.81	7.84	3.61	7.84	2.83	3.00	0.75	1.99	2.07	4.24	2.19	4.50
60	3.49	7.48	3.15	7.24	2.61	2.80	0.61	1.77	1.87	3.90	1.87	4.08
80	3.17	7.12	2.69	6.64	2.39	2.60	0.47	1.55	1.67	3.56	1.55	3.66
100	2.85	6.76	2.23	6.04	2.17	2.40	0.33	1.33	1.47	3.22	1.23	3.24

Rajaram et al. (1988), has seen same results when treated *Vigna mungo seed* with paper mill effluent. Kapoor (1990) Mehta and Bhardwaj (2012) also observed similar effects when treated *Vigna Sinensis* with paper mill effluent. Gupta, D. K. (2004), has also seen same effects when treated *Soyabean* and *Maize* with fly ash. Singh, S. P. (1995) also saw same effect when treated *Vigna sinensis* with paper mill effluent. (1)

Kapoor (1990) and Kumar et al. (2010) observed very similar results when treated *Trigonella foinum graecum* seed with paper mill effluent. Rajannan and oblisami (1993) and Iqbal et al. (2013) observed very similar results when treated *Brassica seeds* with distillery effluent. Upadhyay E. (2004), has seen similar impact of particulate air pollutants on *Brassica Juncea. L. Sharma and kalra (2006) has also seen adverse effect of paper mill effluent on Brassica Nigra.* (2)

Mathur and coworker (1984) have also seen same effect when treated *Allium cepa Seed* with popular industrial effluent. Kapoor (1990) has seen similar effect when treated *Allium cepa Seed* with paper mill effluent. Shrivastava, R. K. (1991), also saw similar effects.

G. Rajannan and G. Oblisami (1971), Kapoor, V.S. (3) (1990) and Singh, S.P. (1995) had seen same effect when treated *Tomato seeds* with paper mill effluent.

CONCLUSION: The root and shoot length of all the observed species was adversely effected on increasing concentration of chlor-alkali plant effluent. The results obtained from these observations that the root and shoot length have some increasing order up to 20%. (4) But from 40% to 100% have some decreasing order when compared to control one. It was documented from above data at 10% and 20% the root and shoot length was found higher than controlled. Adrino et al. (1980) had reported that the growth of seedlings was adversely inhibited in the higher concentration of effluent due to higher alkalinity and excess of different ions. Rai et. al. (2004) has suggested that the excess of salinity may be due to presence of higher amount of sodium hydroxide (NaOH), which can prevent the growth of seedlings in stress conditions.

It is observed that shoot length is higher than root length. The inhibition in root growth appears such that root tip meristem is in direct contact with the polluted effluent which consist of higher level of cations, anions, and total dissolved solids. Kirby (1968), Shrivastava and Sahai (1987), Kadioglu and Algur (1990), Vijaya Kumar and Kumud (1990), Encey and Tiwari (1991) Patel and Ramesh Kumar (1991), Tiwari, Elcey and Bhattia (1993) have also seen retardation in the growth of roots,

Chlor-alkali plant effluent had higher C.O.D (chemical oxygen demand) value. Therefore germinated seeds have got low amount of oxygen in form of dissolved oxygen, restricting their food supply through aerobic respiration which is essential for the growth and development of seedlings, Gould et. al. (1961), Maguir (1973), Mhatre and Chaptekar (1982) and Shaheen et. al. (2005).

Agarwal et al (2011) and other workers have reported on their experiments of certain plant, species that root growth decline in higher concentration of effluents because of its higher alkalinity. Some workers have also proved from their experiments that in excess of effluent, the concentration of salts have also increased and due to this the osmotic pressure of cells have decreased, so the root and shoot growth may be reduced. It seems possible that different types of ions which are present in the soil due to irrigated by effluent, the soil solution inhibit the activity of hydraulic enzymes required at the time of germination and their growth. Jerome and Ferguson (1972).

Reduction in photosynthetic rate may also be considered as a result for the reduced growth of treated seedlings. Mukhiya et. al. (1983), It may be due to the excess of cations, anions and other toxic materials which affects the uptake of water and other metabolic activities, Dollar et. al. (1972), Rajannan and Oblisami (1979), Sahai and Shrivastava (1986), Shrivastava and Sahai (1987) and Patel (2008). Alteration in certain physiological process by a variety of ions individually or in association with each other. Bahadur and Sharma (1988), higher concentration of dissolved salts like NaCl (Sodium Chloride) and sulphate inhibiting the uptake of exchangeable cations (Ca, K, Mg and P). Thabaraj et. al. (1964) and Khan et. al. (2007).

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