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Growth Performance and Chemical Analysis of Some Plants Irrigated with Chlor-alkali Effluent

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ABSTRACT: Nowadays, the major reason of water pollution is industrial effluent. Chlor-alkali effluent disposed from chlor-alkali paper mill is having very high pH, BOD and COD values as well as organic and inorganic materials. Lower concentration of effluents may act as fertilizer but higher concentration has toxic effects. To study impact of Chlor-alkali Effluent (CAE) on plants, seeds of Soyabean (*Glycine max*), Barbati (*Vigna sinensis*) and Tomato (*Lycopersicum esculentum) were selected for experiment*. Parameters selected were height of plant, amount of sugar, non-sugar, protein, ascorbic acid, chlorophyll (a) and chlorophyll (b). Effect of Chlor-alkali effluent was analyzed at different dilutions viz. 10%, 20%, 40%, 60%, 80%, 100% and control. From this experiment, it is clear that with increase of percentage concentration of chlor-alkali effluent, the average length of *Glycine max*, *Vigna sinensis* and *Lycopersicum esculentum* were decreased. Co-relation was also calculated between concentration and plant length, which showed negative value. So far concerned with amount of sugar, non sugar, protein, ascorbic acid, chlorophyll (a) and chlorophyll (b) in case of these plants, the amount of sugar, non sugar, chlorophyll (a) and chlorophyll (b) remain same at 10% and 20% effluent concentration as compared to control condition and decrease from 40% to 100% effluent concentration as compared to control condition where as the amount of protein and ascorbic acid varies in each species.

Keywords: Chlor-alkali effluent; *Glycine max*; *Vigna sinensis* and *Lycopersicum esculentum*.

INTRODUCTION: The air, water and land are three basic amenities of human beings. But the heavy population explosion together with rapid industrialization and subsequent urbanization has led to contamination of these natural resources with undesirable and harmful substances. This phenomenon of fouling of the environment is known as "pollution".

The world health organization (WHO) defined air pollution as "the presence of materials in the air in such concentration which are harmful to man and environment. The term water pollution is referred to as any type of aquatic contamination between following two extremes:

A highly enriched, over productive biotic community, such as river or lake with nutrients from sewage or fertilizer or A body of water poisoned by toxic chemicals which eliminate living organisms or even exclude all forms of life. The land or soil pollution is caused by solid wastes and chemicals. The term "trace element” refers to elements that occur in natural and perturbed systems in small amounts and that, when present in sufficient concentrations, are toxic to living organisms.

The ever increasing demands for some elements give maximum possibility of their dispersal and contact with the environment. An element may be dispersed from time to time, its ore is being mined to the time it becomes usable as a finished product or ingredient of a product. Moreover, increasing demands for fertilizers in high yield agriculture may enhance the possibility. Land disposal techniques that seem promising for agricultural wastes and other solid wastes may also increase the metal burden of soil. There is a great concern regarding heavy metals content in man's environment. Man with the technological advances changes the composition and distribution of atmospheric, heavy metals on the local, regional and global scale. The atmosphere is the vehicle, controlling the dispersal and deposition of heavy metals from source to the receptors. Trace element research has been given importance during last three or four decades followed by episodes of Itai - Itai disease and Minmata disease in Japan.

Irrigation with water polluted with heavy metals leads to heavy metals accumulation not only in the soil but also in the plant including seeds (Banerji and Kumar, 1979). There are several chances wherein seeds may get contaminated by heavy metals. If the treated seeds are sown without the routine washing procedure, the coating of the antifungal powder, forming a moist envelope around a seed, would affect its germination and early growth. In a seedbud, where a large number of seeds are sown in a small area, a sufficiently large quantity of fungicide coating may get accumulated and hamper the initial growth of the seedlings. Cucurbit damage (Crosier, 1950), tomato injury (Dickey and, Ark, 1949) and reduced seedling vigour in pepper (Dempsey and chandler, 1963) are some of the examples of such damage reported.

Heavy metals present in the growing medium causes damage to plant cells, the degree and extent of injury being dependent on the concentration of the metal present. It has been found that toxicity imposed by the heavy metals involves an overall disruption in the synchronization of different metabolic processes occurring in the cells, the resultant effect being manifest in the inhibition of cell division and consequent retardation of growth. It has been demonstrated that the toxic metals are capable of causing a reduction in the activity of hydrolases, viz., amylase, phosphatase, RNAse and protease in germinating seedlings, whereas the activities of catalase, peroxidase, IAA oxidase and ascorbic acid oxidase undergo considerable stimulation. Of all the toxic heavy metals, mercurial compounds seem to be the pioneer pollutants affecting photosynthesis.

Industrial effluents play a major role in pollution of aquatic environment having lots of organic and inorganic compounds. The disposal of these industrial effluents is a major problem throughout the world. 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, CAE also contain trace elements like Co, Ni, Zn and high amount of Hg. Nowadays, at most of the places these industrial effluents are used for irrigation purposes after some treatment.

Lower concentration of CAE may act as fertilizer for crops, yet at higher concentrations, effluents have toxic effects on vegetable plants and crops.

So, it was decided that laboratory studies should also take place to observe the effects of chlor-alkali effluents on plants as well as soil.

MATERIALS AND METHODS: 250 ml of each percentage solution (10% to 100%) was given to each bag after two days of interval, after 10 days from the day of the sowing, growth performance was studied. Parameters were:
Height of the plant and Amount of Sugar, Non-Sugar, protein, Ascorbic acid and chlorophyll (a) and (b).

Amount of sugar and non-sugar were calculated by taking 100 gm oven dry material using spectrometer at 600 and 624 nm respectively.

Protein: Amount of protein was determined by taking 100gm of plant material by spectrophotometer at 650nm.

Ascorbic Acid: Amount of ascorbic acid was calculated by taking 100 gm of plant material through use of spectrophotometer at 640nm.

Chlorophyll: The Amount of chlorophyll (a) and (b) was estimated spectrophoto-meterically at 665 nm and 649 respectively.

RESULTS AND DISCUSSION: From this experiment it is clear that with increasing of percentage concentration of the chlor-alkali effluent the average length of *Glycine max, Vigna sinensis, Lycopersicum esculentum* plants were decreased. Correlation was also calculated between concentration and plant length which showed higher negative value. From the analysis of Glycine max plants which are irrigated by 10% and 20% effluent it was found that amount of sugar, non-sugar, protein and chlorophyll (a) and (b) were the same when they were compared with control irrigated plant. But from 40% to 100% effluent concentration the amount of sugar, non-sugar, protein chlorophyll (a) and (b) were decreased. When compared with the control which are mentioned above.

In case of *Vigna sinensis* plants which are irrigated by 10% and 20% effluent the amount of sugar, non-sugar, protein, chlorophyll (a) and (b) are the same but in case of ascorbic acid 10% to 40 effluent irrigated plant have some result but 60% to 100% effluent concentration have promotory effect of ascorbic acid. Chlorophyll (a) and (b) decreased from 40% to 100% when compared to control. Protein concentration of 10% and 20% effluent irrigated plants have same results but from 40% to 100% concentration, the amount of protein has further gone down. At 10% and 20% effluent concentration, the amount of sugar and non-sugar are like as compared to control but decrease from 40% to 100%.

In case of *Lycopersicum esculentum* at 10% and 20% effluent concentration the amount of sugar, non-sugar, chlorophyll (a) and (b) remains same as compared to controlled but from 40% to 100% effluent concentration, the amount decreases as compared to controlled one. But in case of protein and ascorbic acid at 10%, 20% and 40% effluent concentration the amount of protein and ascorbic acid remains same as compared to controlled one but amount decreases from 60% to 100% effluent concentration as compared to control in case of protein and increases from 60% to 100% effluent concentration as compared to control in case of ascorbic acid.

Table 1: Analysis of 10 days old *Glycine max* plant irrigated by different percentage of effluent

% Effluent	Sugar (g)	Non Sugar (g)	Protein (g)	Ascorbic-acid (mg)	Chlorophyll a (mg)	Chlorophyll b (mg)
10	2.40	8.55	6.00	Nil	517.29	188.60
20	2.40	8.55	6.00	Nil	517.29	188.60
40	2.32	8.10	5.72	Nil	508.05	173.67
60	2.26	7.65	5.60	Nil	487.18	163.92
80	2.12	6.75	5.16	Nil	466.31	154.17
100	2.06	6.75	4.84	Nil	445.44	144.82
Control	2.40	8.55	6.00	Nil	517.29	188.60

Table 2: Analysis of 10 days old *Vigna sinensis* plant irrigated by different percentage of effluent.

% Effluent	Sugar (g)	Non Sugar (g)	Protein (g)	Ascorbic-acid (mg)	Chlorophyll a (mg)	Chlorophyll b (mg)
10	1.00	3.60	3.48	2.50	508.05	173.67
20	1.00	3.60	3.48	2.50	508.05	176.67
40	0.95	3.15	3.20	2.50	487.18	165.92
60	0.90	2.60	3.18	3.33	466.31	153.17
80	0.80	2.25	3.16	3.33	466.31	153.17
100	0.70	2.25	3.12	5.00	424.67	134.67
Control	1.00	3.60	3.48	2.50	508.05	173.67

Table 3: Analysis of 10 days old *Lycopercicum esculentum* plant irrigated by different percentage of effluent.

% Effluent	Sugar (g)	Non Sugar (g)	Protein (g)	Ascorbic-acid (mg)	Chlorophyll a (mg)	Chlorophyll b (mg)
10	1.40	6.30	2.04	4.00	612.40	222.42
20	1.40	6.30	2.04	4.00	612.40	222.42
40	132	5.94	2.04	4.00	591.99	197.74
60	1.20	5.67	1.80	4.40	582.99	197.74
80	1.06	5.40	1.68	5.00	561.62	187.98
100	1.00	4.95	1.44	5.60	519.68	168.49
Control	1.40	6.30	2.04	4.00	612.40	222.42

CONCLUSION: Oxygen is necessary for the respiration of roots and plants, chlor-alkali plant effluents have higher C.O.D. value resulting supply of poor oxygen to root, so growth of plant root is retarded which affects growth of plants directly. Micro organisms present in soil reduce oxygen and increase CO2. Chlor-alkali effluents have sort of dissolved oxygen, so growth of plant is reduced. Roots gain oxygen from soil and by given effluent solution. Chlor-alkali plant effluents have many ions which retard the growth of plants due to higher osmotic pressure of soil. Kadio glue and Algar (1990), Vijay Kumar and Kumud (1991), Patel and Ramesh Kumar (1991).

Due to presence of many ions in effluent like Na^+, Na ion reacts with silicate present in soil to form harder compound Sodium Silicate, so pores of soil are closed causing less aeration and retarding plant growth. Due to hardness of soil, evaporation of soil water is decreased resulting lowering of soil temperature. Due to low temperature of soil, absorption of water by roots further decreased. Micro nutrients cannot reach upto leaf through roots at higher concentration, so plant growth is adversely affected. The pH value of chlor-alkali effluent is very high, so pH of soil is higher. Due to higher pH of soil, growth of roots as well as of plants is retarded.

The phosphate ions present in soil, break off by microbial activity react with Na ions present in effluents to form sodium phosphate resulting in shortage of phosphate in soil which cannot stimulate root growth. Higher concentration of effluents tends to slow down elongation and hastens maturation. Wadlaigh, Gauch and Strong (1947) had grown some plants in soil containing various amounts of salts and found growth of roots was retarded.

Chlor-alkali effluent contains less amount of Mg and K and other mineral ions, inhibiting the synthesis of pigments (chlorophyll) and thus affects photosynthetic activities of plants. Singh (1982), Shrivastava and Sahai (1987). A significant decrease in protein content in all plants irrigated with higher percentage of effluents may be due to higher osmotic pressure as well as its higher D.O. value and presence of some ions and metabolites which are not absorbed by plants during their growth. Kadio glue and Algar (1990).

Another reason for retardation of plant growth can be due to higher concentration of salts and minerals in soils which tend to slow down or stop down root elongation and hasten maturation. White and Rass (1969), Hayward and Blair (1942) have seen this effect.

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