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Research Paper

Irrigational Impact of Sugar Industry Effluent on Vegetative Characters of *Lycopersicon esculentum* Mill. Var. Navodaya

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A B S T R A C T

Five concentration of sugar industry effluent was given in irrigation medium i.e., 20% as T_1, 40% as T_2, 60% as T_3, 80% as T_4 and 100% as T_5. The vegetative characters studied were height of the plant, length of petiole, length of lamina, breadth of lamina, length of stomatal aperture, breadth of stomatal aperture and number of stomata per unit area. Height of the plant was found to increase with the treatment of sugar industry effluent and maximum increase was recorded as 6.62 per cent inT_3 treatment. Maximum increase in the length of petiole was noted in T_2 treatment and it was 21.12 per cent. Length and breadth of lamina was found to increase with treatment of sugar industry effluent and maximum increase were noted in T_3 treatment and it was 20.86 and 19.19 per cent respectively. Length of stomatal aperture was almost unaffected with the treatment of sugar industry effluent; a little increase was recorded in T_1 and T_3 treatment and it was 0.09 per cent and 2.23 per cent respectively. While the treatment T_2, T_4 and T_5 showed a little decrease in the length of stomatal aperture and it was 2.39, 0.23 and 1.1 per cent respectively over the control. Breadth of stomatal aperture also found to be unaffected by the treatment of different concentration of sugar industry effluent. A little increase was recorded in T_2, T_3 and T4 treatment as 2.87 per cent, 4.62 per cent and 1.17 per cent respectively. A little decrease was also recorded in T_1 and T_5 treatments and it was 2.25, and 4.89 percent respectively. Number of stomata per unit area was also found to increase with the irrigation of different concentration of sugar industry effluent and maximum increase was 20.89 per cent in T_3 treatment. It was observed that T_3 treatment where plant were irrigated with 60 per cent concentration of sugar industry effluent was found to enhance the maximum vegetative growth in almost all the parameters taken into consideration except length of petiole. It is concluded that the concentration upto 60 per cent favour the vegetative growth of *Lycopersicon esculentum* Mill. Var Navodaya. The concentration above 60 per cent showed toxic effect on the vegetative growth of tomato plants.

***Key words*:** *Lycopersicon esculentum*, Sugar industry, Effluent, Vegetative characters

Rapid industrialization and urbanization have taken place in our country during last five decades with higher risk of deterioration of environmental quality through discharge of waste by industries and sewage, which challenge the productivity capacity of aquatic ecosystems. It also affects the vegetation of that area where polluted water is used for irrigation. In eastern part of U.P., several diverse types of big industrial units are located. Sugar industry is one of them. It is very important agriculture-based industry of our country. Out of total sugar production in India, U.P. alone produces 25 per cent. These industries are also the fundamental source of Indian economy.

Sugar industry discharge large amount of effluents to the water bodies or on land nearby industrial establishments. These effluents contain several organic and inorganic contents in different proportions. These substances are oil, grease, suspended and volatile solids, chloride, phosphate, phenol, cyanides sulphate, sulphide, pesticide, borax, arsenic, barium, sodium, potassium, cadmium, copper, lead, chromium along with some useful elements like nitrogen, phosphorous, potassium, zinc, magnesium, etc. that are required by the plant [1]. On the other side, some trace element like arsenic, cadmium and mercury are present in sugar industry effluents. This is proved to be toxic for the plant growth [2]. The heavy metals like zinc, copper, and magnesium etc. have favourable effect on mustard, oats and capsicum crops, and are very useful in the soil where reclamation is practically impossible. The present experiment was aimed to study the effect of sugar industry effluent on vegetative characters of *Lycopersicon esculentum* Mill. var. Navodaya. The experiment was conducted at Research Field of Botany Department, Shibli National P.G. College Azamgarh.

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MATERIALS AND METHODS

Sugar industry effluent was collected from "The Kisan Sahkari Chini Mill Limited. Sathiyaon, Azamgarh." and seeds of *Lycopersicon esculentum* Mill. Var. Navodaya was obtained from Agricultural Office, Sidhari Azamgarh. Healthy seeds of uniform size were selected and sterilized with

mercuric chloride solution (0.10 per cent). Different concentrations of sugar industry effluent were used in irrigating medium. These concentrations were 20 per cent (T_1), 40 per cent (T_2), 60 per cent (T_3), 80 per cent (T_4) and 100 per cent (T_5). A control crop was also grown side by side which was named as T_0. The experiment was carried out in factorial randomized block design method at research field Shibli National P.G. College Azamgarh. The effect of different concentration of sugar industry effluent on vegetative growth of *Lycopersicon esculentum* Mill. Var. Navodaya was studied. Statistical comparisons of the mean values were made and data are represented in the given (Table 1).

Table 1 Statistical comparison of the mean values of morphological, characters in between control and treated populations of *Lycopersicon esculentum* Mill. Var. Navodaya.

Characters	Control (T_0)	T_1	T_2	T_3	T_4	T_5	CD*
Height of the plant (cm.)	53.16±1.6279 (37-68)	54.32±1.5098 (43-65)	55.6±0.9273 (45-67)	56.68±2.1921 (40-67)	50.92±2.2827 (35-64)	40.96±1.7888 (30-60)	3.31
Length of petiole (cm.)	1.284±0.0913 (0.3-2.6)	1.4064±0.0652 (0.4-2.5)	1.5552±0.0825 (0.3-2.9)	1.5408±0.1320 (0.3-4)	1.2768±0.1333 (0.2-3.2)	0.9392±0.0.0935 (0.2-2.6)	0.12
Length of lamina (cm.)	6.624±0.0661 (3-10.1)	6.6696±0.1445 (4-9.5)	7.6376±0.1779 (3.6-11)	8.0064±0.2285 (5-10.6)	5.6632±0.1081 (3-8.2)	5.4432±0.2442 (1.1-8.5)	0.22
Breadth of lamina (cm.)	3.4848±0.2040 (1.4-6.3)	3.524±0.2056 (2-6)	3.5464±0.1434 (1.4-7)	4.1536±0.0826 (2-6.7)	3.2464±0.0738 (1.4-5.3)	3.0192±0.0777 (1.5-4.5)	0.16
Length of stomatal aperture (µ)	111.2±4.139 (80.4-174.2)	111.3±3.036 (80.4-160.8)	108.54±1.915 (80.4-160.8)	113.68±3.059 (93.8-174.2)	110.94±3.454 (80.4-174.2)	109.96±4.472 (67-174.2)	4.61
Breadth of stomatal aperture (µ)	63.49±3.1591 (26.8-80.4	62.06±1.5264 (40.280.4)	65.39±1.7237 (40.2-93.8)	66.46±2.0452 (53.6-93.8)	64.24±1.605 (40.2-80.4)	60..38±0.9342 (26.8-67)	3.01
Number of stomata / unit area	30.52±0.9190 (20-45)	32.68±0.5118 (25-41)	36.304±0.7077 (29-50)	36.896±0.4024 (25-50)	21.392±0.3697 (15-30)	18.84±0.3259 (10-29)	9.68

T_0: Control population irrigated with tap water
T_1: Population irrigated with 20per cent of sugar industry effluent
T_2: Population irrigated with 40per cent of sugar industry effluent
T_3: Population irrigated with 60per cent of sugar industry effluent
T_4: Population irrigated with 80per cent of sugar industry effluent
T_5: Population irrigated with 100per cent of sugar industry effluent
*C.D. – Critical difference at 5% level of probability

RESULTS AND DISCUSSION

The vegetative characters studied were height of the plant, length of petiole, length of lamina, breadth of lamina, length of stomatal aperture, breadth of stomatal aperture and number of stomata per unit area. Significant increase in the height of the plant was recorded in T_3 treatment and it was 6.62 per cent as compared to control (Table 1). T_4 and T_5 treatments of sugar industry effluent was used in 80 per cent concentration or directly for irrigation of this crop; it was proved to be toxic for the height of plant and this character decreased by 4.21 per cent in T_4 and 22.94 per cent in T_5 treatment. T_5 treatments were 100 per cent concentration of sugar industry effluent was used for irrigation decreased the height of the plant significantly, and this decrease was 22.44 per cent as compared to control (Table). Height of the plant has been reported to be one of the most important hereditary characters that differ considerably from the variety to variety. Plant height is controlled by its hereditary potentialities and its treatment acting through internal physiological and biochemical process and condition [3]. Length of petiole, another attribute was affected with the irrigation of sugar industry effluent, increase in the length of petiole was recorded in T_1, T_2, T_3 treatments and it was 9.53, 21.12, and 20 per cent respectively. Statistical analysis revealed that all the increase in the length of petiole was non-significant, although T_4 and T_5 treatment decreased the length of petiole and it was 0.56 and 26.85 per cent respectively. Significant decreased in the length of petiole was recorded in T_5 treatment. Length of lamina increases in T_1, T_2, and T_3 treatments and it was 0.69, 15.30 and 20.87 per cent respectively. Maximum increase of 20.87 per cent was recorded in T_3 treatment, where plant received 60 per cent concentration of sugar industry effluent in their irrigation medium. The statistical analysis showed significant increase in the length of lamina in T_2, and T_3 treatment while significant decrease was also noted in T_4 and T_5 treatment and it was 14.50 per cent and 17.80 per cent respectively. Breadth of lamina increases with the treatment of sugar industry effluent and a significant increase of 19.19 per cent was recorded in T_3 treatment where plant received 60 per cent concentration of sugar industry effluent T_4 and T_5 treatment reduces the breadth of lamina and a significant reduction of 13.36 per cent was recorded in T_5 treatment. Length of stomatal aperture was almost unaffected with the treatment of sugar industry effluent; a little increase was recorded in T_1 and T_3 treatment and it was 0.09 per cent and 2.23 per cent respectively. While the treatment T_2, T_4 and T_5 showed a little decrease in the

length of stomatal aperture and it was 2.39, 0.23 and 1.1 per cent respectively over the control. Breadth of stomatal aperture also found to be unaffected by the treatment of different concentration of sugar industry effluent, although a little increase or decrease was recorded but all the increase or decrease was non significant. A little increase was recorded in T_2, T_3 and T_4 treatment as 2.87 per cent, 4.62 per cent and 1.17 per cent respectively. A little decrease was also recorded in T_1 and T_5 treatments and it was 2.25 and 4.89 percent respectively.

Number of stomata per unit area was also studied and it was found that it increases in treatment T_1, T_2, and T_3 treatment and the increase was recorded as 7.07 per cent, 18.95 per cent and 20.89 per cent in T_1, T_2 and T_3 treatment respectively. While T_4 and T_5 treatment decrease the number of stomata per unit area by 29.90 and 38.26 per cent respectively. Statistical analysis reveals that all the increase and decrease in the number of stomata per unit area was significant.

On the basis of above observations it can safely be concluded that all the vegetative characters except length and breadth of stomatal aperture were found to be affected with the application of sugar industry effluent and maximum increase in almost all the vegetative characters' were recorded in T_3 treatment where plant was irrigated with 60 per cent concentration of sugar industry effluent. Vigorous vegetative growth in different plants with the effect of several industrial effluents in different concentration as reported by other workers [4-8].

pH range 4-9 generally favour the growth of plant. Several species showed the maximum growth if the pH of soil lies between 5-7. The pH affects salt absorption in several ways. At low pH, the hydrogen ion usually decreased absorption of cations. While ion absorption may be stimulated. As hydrogen ion, compete with cations for uptake of hydroxyl or bicarbonate ion present. At higher pH, compete with nitrate, chloride and phosphate ions pH, strongly affect the uptake of phosphate because it influences the ionic charges. The pH of sugar industry effluent ranges from 6-7, which is the best growth range observed in the species of *Capsicum* and *Lycopersicon esculentum* var. Navodaya that may be the reason while the vegetative growth of *Lycopersicon esculentum* mill var. Navodaya increases with the application of sugar industry effluent in suitable dilution. The component present in sugar industry effluent, which may affect the growth and development of plant, are nitrogen, magnesium, potassium, sulphate, phosphate, chloride, and zinc, copper. Chromium. Cadmium etc. sugar industry effluent contains 10 mg per litre nitrogen and nitrogen play an important role in the formation of several organic compound such as amino acid, protein, Nucleic acid, alkaloid and vitamins. Sugar industry effluent contains about 80 mg per litre magnesium. Magnesium plays important role in protein synthesis as it is involved in binding of the ribosomal particles. Although excessive amount of magnesium is injurious to the plant causing rolling and curling of leaf. It also involves in enzymatic reaction during photosynthesis. Sugar industry effluent contains 1.25 mg per litre phosphate. Phosphorous play significant role in living system especially in energy transfer. Sugar industry effluent also contain180 mg per litre calcium. It is a cellular component in the form of calcium pectate in middle lamella of cell wall. It also plays significant role in the organization of cell membrane and chromatin. Sugar industry effluent contains about 500 mg per litre sulphate. Sulphate is distributed in various tissue of the plant. It is component of protein; it is involved in plant cell energetics, Vigorous vegetative growth in *Brassica compestris* by the irrigation of 80 per cent sugar industry effluent as reported by [9]. Vigorous vegetative growth in *Pisum sativum* L. var. Rachna irrigated with 60 and 80 per cent of sugar industry effluent [10].

CONCLUSION

From the above discussion it may concluded that sugar industry effluent which is harmful for the human being, is beneficial for the plants if applied in proper concentration specially for *Lycopersicon esculentum* Mill. Var. Navodaya. Therefore, it is recommended that this effluent may be safely used in 60 per cent concentration for irrigation of crops field of *Lycopersicon esculentum*. Mill var. Navodaya. The sugar industry effluent, which is toxic for the aquatic ecosystem and field crops, may be used as liquid fertilizer for economically important crop like tomato in proper dilution.

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