International Journal of Scientific Research in Science and Technology
Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)
doi : https://doi.org/10.32628/IJSRST

Effect of Sugar Mill Wastewater on Vegetative Characters of *Lycopersicon esculentum* Mill. Var. S-22.

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Article Info

Volume 9, Issue 3

Page Number : 387-392

Publication Issue

May-June-2022

Article History

Accepted : 01 June 2022

Published : 05 June 2022

ABSTRACT

Sugar industry wastewater was used as irrigation medium in five different concentrations i.e. 20% as T1, 40% as T2, 60% as T3, 80% as T4 and 100% as T5. 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 14.60 per cent inT3 treatment. Maximum increase in the length of petiole was noted in T3 treatment and it was 15.19 per cent. Length and breadth of lamina was found to increase with treatment of sugar industry effluent and maximum increase were noted in T3 treatment and it was 38.09 and 8.41 per cent respectively. Length of stomatal aperture was almost unaffected with the treatment of sugar industry effluent, a little increase was recorded in T1 treatment and it was 2.43 per cent. While the treatment T2, T3, T4 and T5 showed a little decrease in the length of stomatal aperture and it was 0.39, 0.68, 1.26 and 4.56 per cent respectively over the control. Breadth of stomatal aperture irrigated with different concentration of sugar industry effluent was made. Treatments T1, T2 and T3 significantly enhance the breadth of stomatal aperture by 6.85, 14.42 and 15.30 per cent. Treatment T4 showed a decrease of 0.34 per cent over control. The T5 treatment decreases the breadth of stomatal aperture by 8.63 per cent as compared to control. 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 24.40 per cent in T3 treatment. It was observed that T3 treatment was found to enhance the maximum vegetative growth in almost all the parameters taken in to consideration except length of stomatal aperture. It is concluded that the concentration up to 60 per cent favor the vegetative growth of Lycopersicon esculentum Mill. Var S-22. The concentration above 60 per cent showed toxic effect on the vegetative growth of Tomato plants.

Keywords : Sugar Mill Waste-water, Lycopersicon esculentum Mill. Var S-22, Treatments (T0, T1, T2, T3, T4 and T5), Vegetative characters.

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I. INTRODUCTION

The disposal of factory effluents in nearby area is a usual practice. Land application of waste-water was preferred as an alternative for its disposal, since soil is believed to have the capacity of decomposing the wastes and pollutants where organic matter are stabilized by the activities of soil microbes (Young et al., 1981). Use of wastewater in agriculture is gaining importance now a day. Effluents are hazardous to aquatic plants, animals and human beings and it is major concern for existing environment. However, some effluents at certain dilutions are found to be beneficial for irrigation purposes (Taghavi and Vora, 1994). Therefore, the use of effluents in irrigation may be the suitable option for its safe disposal. Use of waste-water for irrigation makes it possible to conserve the limited water resources for crop production and prevent pollution of water bodies. The application of waste-water to agricultural land may promote the growth of crops and conserve water and nutrients.. It is therefore, necessary that some practical solution must be placed to handle enormous qualities of sugar industry effluent. Therefore, controlled land application Technology has to be developed for different crop and cropping system for ensuring effective management and utilization of sugar industry effluent. This would not only solve the problem of waste water disposal but also ensure recycling of nutrients resulting in sustaining soil fertility and productivity.

II. METHODS AND MATERIAL

The field experiments on two varieties of Lycopersicon esculentum Var. S- 22 were carried out on “Rabi” (winter) season in the Botanical research field at Shibli National P.G. College, Azamgarh. The experiments were conducted in factorial randomized block design. The area was ploughed thoroughly to break up the soil's surface layer and maintain optimal soil aeration, which aids in root penetration, organic matter mixing, and nutrient distribution throughout the soil. For each treatment, 1 X 1 sq. m plots were created and moderately irrigated before sowing to preserve moisture and promote proper germination. Standard agricultural procedures were used to grow the crop of Lycopersicon esculentum Var. S- 22. The seeds of Lycopersicon esculentum Mill. Var S- 22 was obtained from agricultural office, sidhari Azamgarh. The viability of the healthy seeds of uniform size was determined. Seeds were surface sterilized with a 0.1 percent mercuric chloride solution. The effluent was collected from “The Kisan Sahkari Chini Mill. Ltd”. Sathiyaon, Azamgarh (UP). Sugar industry effluent used as irrigation medium as different concentrations such as 20 per cent, 40 per cent, 60 per cent, 80 per cent and 100 per cent contains some important nutrients along with several toxic substances. The elements present in the effluent of sugar industry are nitrogen, phosphorus, potassium, magnesium, iron, chromium, boron, zinc, etc. It also contains sulphur in the form of sulphate and sulphite. Toxic element includes oil and grease, chloride, phosphate, phenol, cyanide, pesticides, borax, arsenic, barium, sodium, cadmium, copper, lead, chromium, mercury, nickel, silver, zinc, chloroform, reducing sugar, non-fermented sugar etc. The chemical composition of the effluent obtained from chemical cell of sugar Mill, Sathiyaon, Azamgarh”.

III. RESULTS AND DISCUSSION

The abiotic components of the environment which supports the existence of life on the Earth are air, water and soil and proper management of these environmental components is important for the healthy life. If any kind of disbalance occurs it effect the survival of the living being. Sugar industry effluent contains several chemical substances along with a huge amount of water. The effluent contains several toxic substances which may affect the survival of biotic component. It also causes skin disease when used in bathing (Beg and Kumar, 2010). Several

workers however found that the chemicals which are present in sugar industry effluent play a beneficial role in growth and development of plants. It includes macro-nutrients such as nitrogen, phosphorous, potassium, sulphur and several micro-nutrients like zinc, magnesium, copper, chromium etc. (Mathur, 1975; Ajmal and Khan, 1983; Vohra, 1994; Kumar, 2004; Taghavi and Ahmad and Beg, 2015; Kashif and Beg, 2021 etc.). Therefore, experiments were planned on the utilization of these macro and micro-nutrients present in the sugar industry effluent at different concentration by an important crop of the world as well as our country namely Lycopersicon esculentum species. The plants were irrigated with 20, 40, 60, 80 and 100 per cent concentration of sugar industry effluent named as T1, T2, T3, T4, and T5 respectively. A control crop was also grown side by side which was irrigated by tap water (T0).

The vegetative parameters studied were plant height, length and breadth of lamina, length and breadth of stomatal aperture and number of stomata per unit area sugar industry effluent was used in the irrigation medium of Lycopersicon esculentum Mill. Var S-22 and all the vegetative were tested and data are presented in Table. Lycopersicon esculentum Mill. var S-22 showed increase in the height of the plant in T1, T2 and T3 treatments (Table) and it was 4.13, 8.70 and 14.60 per cent respectively. Maximum increase was recorded in T3 treatment. Statistical analysis revealed that treatment T2 and T3 significantly increase the height of the plants. Treatment T4 and T5 showed adverse effect on the height of the plant. A significant decrease of 39.45 per cent over control crop was recorded in T5 treatment (Table). The length of petiole of Lycopersicon esculentum Mill. Var. S -22 and its population irrigated with different concentration of sugar industry effluent were found to be affected. The treatments (T1, T2 and T3) showed increase in the length of petiole by 10.78, 11.67, and 15.19 per cent respectively as compared to control (Table). Maximum increase was recorded in T3 treatment. Treatment T2 and T3 showed significant increase by 30.67 per cent and 37.22 per cent respectively as compared to control. Statistical analysis revealed that all the increase and decrease were significant except T1 (Table). The length of lamina of Lycopersicon esculentum Mill. Var S -22 was affected with the effect of different concentration of sugar industry effluent. Twenty (T1) per cent concentration of sugar industry effluent significantly increase the length of the lamina by 9.98 per cent as compared to control. Irrigation with 40 per cent concentration of sugar industry effluent (T2) increases the length of lamina by 32.30 per cent. The length of lamina was significantly increases in T3 treatments by 38.09 per cent (Table). Treatments T4 and T5 where plant irrigated with 80 per cent and 100 per cent concentration of sugar industry effluent showed adverse effect on the length of lamina. T4 treatment decreases the length of lamina by 3.38 per cent and T5 treatment decreases 5.67 per cent as compared to control (Table). Mean values of breadth of lamina in Lycopersicon esculentum Mill. Var. S -22 and the population irrigated with different concentration of sugar industry effluent was compared and statistically analysed, data are presented in Table. Twenty per cent concentration of sugar industry effluent was found to increase the breadth of lamina of the crop by 0.48 per cent as compared to control and this increase was non-significant Although when the crop irrigated with 40 and 60 per cent concentration of sugar industry effluent (T2, and T3) significantly increase the breadth of lamina by 4.33 and 8.41 per cent. Maximum increase in the breadth of lamina was noted in T3 treatments i.e. 60 per cent concentration of sugar industry effluent. Statistical analysis showed that treatments T4 and T5 decrease the breadth of lamina by 0.63 and 0.82 per cent and this decrease was non-significant (Table).The length of stomatal aperture of Lycopersicon esculentum Mill. Var. S -22 is also unaffected with the irrigation of different concentration of sugar industry effluent. Twenty per cent concentration of sugar industry effluent was found to increase the length of stomatal aperture by

2.43 per cent, as compared to control. At 40 per cent concentration of sugar industry effluent (T2 treatment), the length of stomatal aperture of Lycopersicon esculentum Mill. Var. S -22 decreased by 0.39 per cent as compared to its control. While in 60 per cent concentration of sugar industry effluent (T3) decreased the length of stomatal aperture by 0.68 per cent as compared with control. T4 treatment decreases the length of stomatal aperture by 1.26 per cent as compared to control. The T5 treatment it means 100 per cent concentration of sugar industry effluent, showed the decrease in the length of stomatal aperture by 4.56 per cent as compared to control. Statistical analysis revealed that there is a little increase or decrease in the length of stomatal aperture and this fluctuation was found non – significant (Table). Breadth of stomatal aperture of Lycopersicon esculentum Mill. Var. S -22 and the population irrigated with different concentration of sugar industry effluent was made and data are represented in Table. Treatments T1, T2 and T3 significantly enhance the breadth of stomatal aperture by 6.85, 14.42 and 15.30 per cent. Treatment T4 (80 per cent concentration of sugar industry effluent) showed a decrease of 0.34 per cent over control. The T5 treatment (100 per cent concentration of sugar industry effluent) decreases the breadth of stomatal aperture by 8.63 per cent as compared to control (Table). Number of stomata per unit area in Lycopersicon esculentum Mill. Var S -22 significantly increase or decrease with the application of sugar industry effluent. Treatments T1, T2, and T3 increases the number of stomata per unit area by 10.29, 11.26 and 24.40 per cent respectively. Treatments T4 and T5 showed a decrease of 26.57 and 34.71 per cent respectively as compared to control (Table). Lycopersicon esculentum Mill. var S-22 were irrigated with different concentration of sugar industry effluent and it was noted that almost all the vegetative characters (plant height, length of petiole, length and breadth of lamina, length and breadth of stomatal aperture and number of stomata per unit area increases with the increase of sugar industry effluent and maximum increase was recorded in T3 treatments where plants were irrigated with 60 per cent concentration of sugar industry effluent. Almost same type of observations has already been reported earlier by a number of workers on different crops and different effluent. Positive response of fertilizer factory effluent on seedling growth of Phaseolus radiatus was reported by Sahai et al, (1979). Positive effect of sugar Mill. and distillery effluent on seedling length of rice plant was reported by Singh et al., (1985). Change in stomatal behaviour in Cynodon dactylon with the effect of distillery effluent was noted by Bhosle in 1985. Ahmad and Beg (2015) reported enhancement of overall vegetative growth in Capsicum annum var Grossum by the application of sugar industry effluent. Beg et. al., (2015) observed similar types of result in Vicia faba; Cicer arietinum and Cajanus cajan using paper industry effluent. The vigorous growth in the morphological characters of Lycopersicon esculentum Mill. Var S-22 may be due to the presence of nitrogen, phosphorous and zinc in the effluent of sugar industry effluent. These elements are essential for morphological growth of the plants in general.

IV. Acknowledgement

The first author is grateful to the Principal Shibli National College, Azamgarh for providing experimental field and laboratory facilities for conducting the present experiment. The author is also grateful to the chief pharmacists, Sahkari Chini Mil, Sathiyaon azamgarh for providing sugar industry effluent on our demand.

Table 1. Comparison of the mean values of vegetative characters in between control and treated populations of Lycopersicon esculentum Mill. Var. S-22.

S.No	Characters'	T_0	T_1	T_2	T_3	T_4	T_5	CD
1.	Height of the plant (cm)	54.24 ±2.130021 (45-66)	56.48 ±1.330176 (50-65)	58.96 ±3.278535 (45-78)	62.16 ±3.423971 (45-78)	52.2 ±1.512067 (39-65)	32.84 ±1.526669 (15-49)	3.312
2.	Length of petiole (cm)	1.3432 ±0.05348 (0.1-2.9)	1.488 ±.0.09531 (0.1-4)	1.5 ±0.12685 (0.4-3.2)	1.5472 ±0.06385 (0.3-3.4)	0.9312 ±0.03557 (0.1-21)	0.8432 ±0.07354 (0.1-2.5)	0.121
3.	Length of lamina (cm)	5.6584 ±0.1989 (3-9)	6.2232 ±0.2714 (3.5-9.5)	7.4864 ±0.3079 (4.5-10.2)	7.8136 ±.0.2633 (5.1-10.2)	5.4672 ±0.1952 (2.3-9)	5.3376 ±0.1601 (2.9-8.5)	0.228
4.	Breadth of lamina (cm)	3.508 ±0.21462 (1.5-6.5)	3.5248 ±0.1953 (1.9-6.5)	3.66 ±0.14833 (2.1-5.2)	3.8032 ±0.15896 (2-7)	3.4856 ±0.05314 (1.5-5.7)	3.4792 ±0.18667 (1.2-7.6)	0.155
5.	Length of stomatal aperture (µ)	102.9 ±3.638 (67-160.8)	105.38 ±3.389 (67-147.4)	120.94 ±1.634 (80.4-160.8)	130.24 ±1.258 (107.2-174.2)	101.65 ±2.33 (80.4-147.4)	98.19 ±1.38 (80.4-120.6)	4.61
6.	Breadth of stomatal aperture (µ)	60.8962 ±3.1231 (40.2-93.80	65.0704 ±0.3756 (53.6-80.4)	69.68 ±1.332 (53.6-93.8)	70.216 ±0.8816 (53.6-107.2)	60.568 ±1.5997 (40.2-80.4)	55.6392 ±0.8425 (26.8-80.4)	3.01
7.	Number of stomata per unit area	30.472 ±0.898859 (20-45)	33.608 ±0.769994 (20-45)	33.904 ±0.810727 (20-50)	37.848 ±1.90694 (20-51)	22.376 ±1.133186 (10-35)	19.896 ±0.472592 (10-28)	0.72

T0= Control population irrigated with tap water
T1= Population irrigated with 20 per cent concentration of sugar industry effluent.
T2= Population irrigated with 40 per cent concentration of sugar industry effluent.
T3= Population irrigated with 60 per cent concentration of sugar industry effluent.
T4= Population irrigated with 80 per cent concentration of sugar industry effluent.
T5= Population irrigated with 100 per cent concentration of sugar industry effluent

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Cite this article as :

Mohd Kashif, M. Z. Beg, "Effect of Sugar Mill Wastewater on Vegetative Characters of Lycopersicon esculentum Mill. Var. S-22.", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 9 Issue 3, pp. 387-392, May-June 2022.
Journal URL : https://ijsrst.com/IJSRST229348