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Analysis of Sugar Industry Discharge on Yield of Tomato Crop (*Lycopersicon esculentum* Mill. Var. S-22.)

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Vegetables play significant role in our life as protective food and most beneficial for the health maintenance and disease prevention. Vegetables have valuable food ingredients that can be easily utilized to build up and repair the body [1]. Tomato is one of the major vegetable crops of our country. Although its worldwide production is about 126 million tons in 2005. Vegetables are indeed an important part of the human diet because they include essential carbohydrates, proteins, vitamins, minerals, and fibres. Tomatoes (*Lycopersicon esculentum*) are one of the world's most extensively cultivated crops [2]. However about 180 million tones productions of fresh tomatoes were recorded on annual basis as per reports (source: Internet data taken from tomatonews.com). India stands second after China with annual yield of 18.399 tons with yield on an average of 24.21 tons per hectare. Several nutrients and secondary metabolites are found in tomato which is important for human health. The Mineral nutrients, Vitamins, β -carotene, lycopene, flavonoids, organic acids, phenolics and chlorophyll [3]. In our country it is grown in all the states covering over 310 thousand hectares with an annual production of 4600 thousand tones [4]. Water is a fundamental and priceless natural resource that is essential to existence. It is the global nexus for the evolution of civilizations and has a critical influence in a country's socioeconomic growth. Due to decreased supply and demand in numerous industries, water has become a severe economic, social, and political concern in the last two decades. Due to a lack of water for irrigation, irrigating crops with effluents is a frequent technique in India [5-6]. In many parts of the world, wastewater/ effluents from agro industrial units, distillers, and domestic or municipal effluents are used in agriculture in addition to domestic wastewater. On crops such as vegetables, wastewater irrigation has both positive and negative effects [7-8].

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, $1 \times 1 \text{ m}^2$ 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 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”. The data generated in the study was analyzed by using standard statistical procedure through CD (critical difference) was calculated by ANOVA for each character as suggested by Panse and Sukhatme [9].

Effect of different concentration of sugar industry effluent on several yield characters of *Lycopersicon esculentum* Mill. Var. S-22 was studied and compared with control population. It was observed that diameter of flower in *Lycopersicon esculentum* Mill. Var. S -22 significantly increases in T_1 , T_2 and T_3 treatments and maximum increase was recorded in T_3 treatment and it was 11.79 per cent as compare to control (Table 1). Treatment T_4 and T_5 significantly decreases the diameter of flower and by 4.72 per cent in treatment T_5 . The length of anther significantly increases in T_1 , T_2 and T_3 treatments. Maximum increase was recorded in T_3 treatment and it was 33.60 per cent as compare to control plant. Treatment T_4 and T_5 were found to be toxic to the length of

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anther. T₄ treatment showed decrease in the length of anther by 7.76 per cent. While T₅ treatment decreased the anther length by 12.32 per cent. Pollen fertility is affected by the irrigation of different concentration of sugar industry effluent. Twenty per cent concentration of sugar industry effluent increases the pollen fertility by 4.50 per cent as compared to control. At 40 per cent the pollen fertility increases by 5.97 per cent as compared to its control. T₃ treatment showed an increase in the pollen fertility by 7.19 per cent only as compared with control. All the treatment excluding T₁ that is treatment T₂ & T₃ showed a little increase in the pollen fertility. Treatment T₄ and T₅ showed decrease in the pollen fertility by 4.21 and 16.58 per cent respectively. Flowers per inflorescence of *L. esculentum* Mill. Var. S -22 significantly increases with the irrigation of different concentration of sugar industry effluent up to the 60

per cent concentration of sugar industry effluent. Maximum increase was recorded in T₃ treatment and it was 39.64 per cent as compare to control. The treatment T₄ and T₅ decreases the number of flowers per inflorescence. T₄ treatment decreases the number of flowers per inflorescence by 51.18 per cent as compared to control. While T₅ treatment decreases it by 54.14 per cent as compared to control. The number of inflorescences per plant of *L. esculentum* Mill. Var. S -22 affected with the effect of different concentration of sugar industry effluent. T₁ treatment increases it by 9.85 per cent as compared to control. T₂ and T₃ treatment showed significant increase of number of inflorescences per plant by 18.71 and 19.21 per cent respectively, as compare to its control [10]. T₄ and T₅ treatments significantly decrease the number of inflorescences per plant by 38.42 and 58.12 per cent respectively as compared to control.

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

Characters	T ₀	T ₁	T ₂	T ₃	T ₄	T ₅	CD
Diameter of flowers (cm)	2.3192±0.15524 (1.2-3.4)	2.4264±0.08554 (1.2-3.5)	2.5528±0.1379 (1.5-4)	2.5928±0.12635 (1.5-3.5)	2.2976±0.09659 (1.5-3.5)	2.2096±0.23085 (1.2-3.5)	0.08
Length of anther (mm)	7.192±0.2657 (4-9.5)	8.8176±0.1024 (6.5-11.5)	9.22±0.1359 (6-10.6)	9.6088±0.0803 (8-10.6)	6.6336±0.1706 (4-9.5)	6.3056±0.3873 (4-9)	0.23
Pollen fertility (%)	72.36±0.863781 (57.14-85.65)	75.62±0.851462 (60.95-86.39)	76.78±1.379752 (49.67-96.1)	77.56±0.700023 (61.72-94.25)	69.31±0.29828 (53.38-77.77)	60.36±0.455625 (50-69.72)	2.05
Number of Flower per inflorescence	4.296±0.124 (1-7)	4.44±0.389 (1-8)	4.52±0.142 (1-9)	4.616±0.19 (2-8)	3.904±0.221 (1-7)	3.576±0.078 (1-7)	3.31
Number of inflorescence per plant	16.24±0.97 (3-13)	17.84±0.888 (4-14)	19.28±0.202 (6-13)	19.36±1.18 (5-17)	10±0.516 (1-9)	6.80±0.146 (1-6)	2.23
Number of fruits per plant	40±0.149 (3-8)	42.5±0.3 (3-9)	44.44±0.126 (2-12)	50.24±0.433 (2-13)	43.60±0.106 (1-5)	10.60±0.202 (1-6)	1.96
Number of seeds per fruit	43.832±6.63667 (6-97)	48.936±2.44097 (10-75)	53.192±3.41617 (15-110)	78.192±11.0896 (6-171)	42.792±2.2499 (15-85)	29.288±4.7984 (10-49)	2.87
Weight of fruit (gm)	56.624±1.7038 (30-87)	58.32±0.3609 (35-85)	67.848±1.6982 (40-91)	76.936±4.8062 (36-130)	39.984±0.9442 (15-65)	27.008±2.5643 (11-55)	0.24
Productivity per Plant (Kg)	2.265	2.487	3.002	3.409	1.743	0.286	0.49

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

Significant increase in fruits number per plant was recorded in T₂ and T₃ treatments and it was 8.75 and 10.70 per cent as compare to control. T₄ and T₅ treatments significantly decrease it by 9.73 and 14.59 per cent as compared to control respectively. Maximum increase was recorded in T₃ treatments. Treatment T₄ and T₅ showed significant decrease in the number of fruits per plant (Table 1). Significant increase in number of seeds per fruit was recorded in T₁, T₂ and T₃ treatments and it was 11.64, 21.35 and 78.39 per cent respectively over control population of *Lycopersicon esculentum* Mill. var S-22. Treatments T₄ and T₅ decreases the number of seeds per plant by 2.37 and 10.37 per cent respectively. Weight of the fruit showed significant increase in T₂ and T₃ treatments and it was 19.82 and 35.87 per cent respectively. While treatments T₄ and T₅ showed significant decrease in weight of the fruits. Fruit productivity per plant significantly increases in T₂ and T₃ treatments. Maximum increase was recorded in T₃ treatments and it was 50.44 per cent as compared to control [11-12]. *Lycopersicon esculentum* Mill. var S-22 was irrigated with different concentration of sugar industry effluent and it was

noted that almost all the yield characters like diameter of flower, length of anther, number of inflorescence per plant, number of fruits per plant, number of seeds per fruits, average weight of the fruit and productivity per plant, increases with the increase of sugar industry effluent and maximum increase was recorded in T₃ treatments where plants were irrigated with 60 percent 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 [13-15].

SUMMARY

In the irrigation medium, five different concentrations of sugar industry effluent were being used: 20% as T₁, 40% as T₂, 60% as T₃, 80% as T₄, and 100% as T₅. The diameter of the flower, length of the anther, pollen fertility, number of flowers per inflorescence, number of inflorescences per plant, number of fruits per plant, diameter of fruit, number of seeds per fruits, average of fruit, and productivity per plant were all investigated

as yield characters. Diameter of flower was found to increase with the treatment of sugar industry effluent and maximum increase was recorded as 7.49 percent in T₃ treatment. Maximum increase in the length of anther was noted as 23.53 per cent in T₃ treatment. Pollen fertility was almost unaffected with the treatment of sugar industry effluent a little increase of 3.47 per cent was recorded in T₂ treatment. Number of flowers per inflorescence was also found to increase and maximum increase was recorded in T₃ treatment and it was 15.69 per cent as compared to control. Number of inflorescences per plant was also affected with the treatment of sugar industry effluent and T₃ treatment where plant received 60 per cent concentration of sugar industry effluent showed maximum increase of 22.07 per cent as compared to control. Number of fruits per inflorescence was found to increase with the increase of concentration of sugar industry effluent and maximum increase was recorded in T₃ treatment and it was 28.89 per cent as compared to control.

Diameter of fruit was found to increase and maximum increase was noted as 22.13 per cent over control in T₃ treatment. Number of seeds per fruit and average weight of the fruit were also found to increase with the increase of sugar industry effluent up to 60 per cent and maximum increase was recorded as 29.66 per cent and 53.71 per cent respectively, over control. Fruit productivity per plant was found to be affected by the treatment of sugar industry effluent and maximum increase of 98.16 per cent was recorded in T₃ treatment. It was observed that T₃ treatment where plants were irrigated with 60 per cent concentration of sugar industry effluent was found to enhance the maximum in almost all the yield parameters taken in to consideration. It is concluded that the concentration up to 60 per cent favours the yield characteristics of *Lycopersicon esculentum* Mill. Var. S-22. The concentration above 60 per cent showed toxic effect on almost all the yield parameter including fruit productivity of tomato crop.

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