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ORIGINAL ARTICLE

Growth Response of Morphological Parameters of Wheat Crop (*Triticum Aestivum* L.) with Different Concentration of Sugar Mill Effluents

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ABSTRACT

The present investigation has been carried out to study the effect of concentration of sugar mill effluents on morphological parameters of wheat crop like root length, shoot length, fresh weight, dry weight etc. The test crop was exposed to different concentrations of sugar mill effluent i.e. 0 %, 25 %, 50 % and 100 % and various parameters were recorded. This study reveals that the sugar mill effluents can be used for irrigation after proper dilution.

Key words: *concentration, root length, shoot length, sugar mill effluents*

INTRODUCTION

Indian economy is an agrarian economy. 70 per cent of the population of this country relies on agriculture. Sugar industries are creating mega impact in India's economy as well as generating employment including laborers, technicians and transport operators (Rajukkannu and Manickam, 1997; Saranraj and Stella, 2014). A considerable amount of effluent is released during sugar cane crushing which is causing a serious problem of water bodies affecting the crops quality as well yield (Maliwal, 2004). These effluents although increase the nutrient level of the soil but also cause toxicity (Mishra and Sahoo, 1999). The effects of various industrial effluents on germination of seeds, growth of plants and yield of crops have fascinated the attention of many workers (Ozoh, 1984). Wastewater use is increasing in urban agriculture which derives significant economic activity and supports the livelihood of poor farmers. A study has been done to see the effect of different concentration of sugar mill effluents on morphological parameters of wheat plant.

MATERIALS AND METHODS

The sugar mill waste was taken from Cooperative Sugar Mills, Meham, Haryana, India. It is located at 28°59'49.2"N 76°14'30.1"E. Sugar mill effluent (SME) samples were collected and used in different concentrations for studying their effect on morphological parameters of wheat crop. Experiment was performed from November 2015 to April 2016. Experimental pots of 50 X 50 cm^2 in triplicates were used. Seeds of Wheat *(Triticum aestivum* L.) were purchased and sown in pots irrigated with different concentrations (0 %, 25 %, 50 % and 100 %) of sugar mill effluents. The seeds irrigated with BWW (Bore Well Water) were treated as control (S1W1) and all pots were examined regularly for germination of seeds and morphological parameters of wheat plants. First irrigation was done to all pots with blank water and then with different concentrations of sugar mill effluents for seven days before sowing.

Factor water was in the ratio given below:

W1: Irrigation with fresh water or BWW containing 100 % blank water (1: 0)
W2: Irrigation with mixture containing 75 % BWW and 25 % waste water (dilution ratio 1:3)
W3: Irrigation with mixture containing 50 % BWW and 50 % waste water (dilution ratio 1:1)
W4: Irrigation with undiluted waste water containing 0 % blank water (0:1)

Factor soil was in the ratio given below:

S1: Soil of fields containing 100 % blank water (1: 0)
S2: Soil watered with BWW and sugar mill effluents in the ratio 3: 1

S3: Soil watered with BWW and sugar mill effluents in the ratio 1: 1
S4: Soil watered with sugar mill effluents containing 0 % blank water (0:1)

So total 16 samples were there of different combinations of soil and water. The different concentrations (0 %, 25 %, 50 % and 100 %) of sugar mill effluents were prepared with tap water. Pots were regularly monitored for various parameters like Root and shoot lengths, seedling length, fresh and total dry masses of wheat seedlings were recorded after ten days of experiment.
The leaf area of the leaves were determined by the equation given by Montgomery (1911). To calculate leaf area from leaf length and width measurements as given by the equation:-

$$LA = L^* W * A$$

Where, LA= leaf area
L, W, and A are, leaf length, leaf width and a constant (0.75) respectively. This was calculated on 30, 60 and 90 days of the experiment.

RESULT AND DISCUSSION

Root Length (RL) and Shoot Length (SL):

The root and shoot lengths of seedlings were determined 10 Days after Sowing (DAS) by using a scale. The sum total of both (root and shoot) gives us the length of seedlings. The values of RL and SL of all the samples of different effluent concentrations are given in the Table 1 and their comparison in Figure 1 and shows clearly that the values are lowest for S4W3 and S4W4 and highest for S2W3, S3W2, S3W3. This is in conformity with earlier findings that low concentration of effluents has positive effect on crops.

Table 1: Shoot Length, Root Length of various samples of different effluent concentrations (Mean±SD of six values)

Samples	Shoot Length(cm)	Root Length(cm)
S1W1	7.92±0.3	6.65±0.086
S1W2	7.81±0.15	6.51±0.04
S1W3	8.11±0.19	7.11±0.05
S1W4	3.52±0.079	3.08±0.038
S2W1	8.41±0.1	7.12±0.029
S2W2	8.45±0.12	7.1±0.033
S2W3	8.92±0.06	7.25±0.034
S2W4	2.79±0.11	1.43±0.025
S3W1	8.5±0.074	7.28±0.038
S3W2	8.69±0.07	8.47±0.043
S3W3	8.99±0.041	8.92±0.033
S3W4	3.82±0.065	2.08±0.042
S4W1	2.21±0.047	1.86±0.058
S4W2	1.39±0.05	1.91±0.033
S4W3	1.28±0.02	1.42±0.035
S4W4	1.18±0.039	1.26±0.02

Fresh Weight, Dry Weight and Moisture Content:

The fresh and total dry weights of wheat seedlings were determined after ten days of the experiment as shown in Table 2 and their comparison in Figure 2, Figure 3 and Figure 4. The plants were washed thoroughly with distilled water and were dried for 2 h under natural conditions in open roof. The fresh weights were taken and then the plants were packed in paper envelopes and oven dried for 36 h at 70^{o}C and the dry weight of each plant was also recorded. Figure 2 and Figure 3 showed clearly that fresh and dry weights are lowest for S4W3 and S4W4 and highest for S3W2 and S3W3. The difference of both these i.e. fresh weights and dry weights of the seedlings gives the moisture content of the seedlings. Thus, it is also lowest for S4W3 and S4W4 and but highest for S1W3 and S3W3 when compared with different treatment conditions and which clearly shows that effluent with low concentration contribute significantly in the weight of wheat plant but high concentration of SME has negative effect on weight and moisture content of wheat.

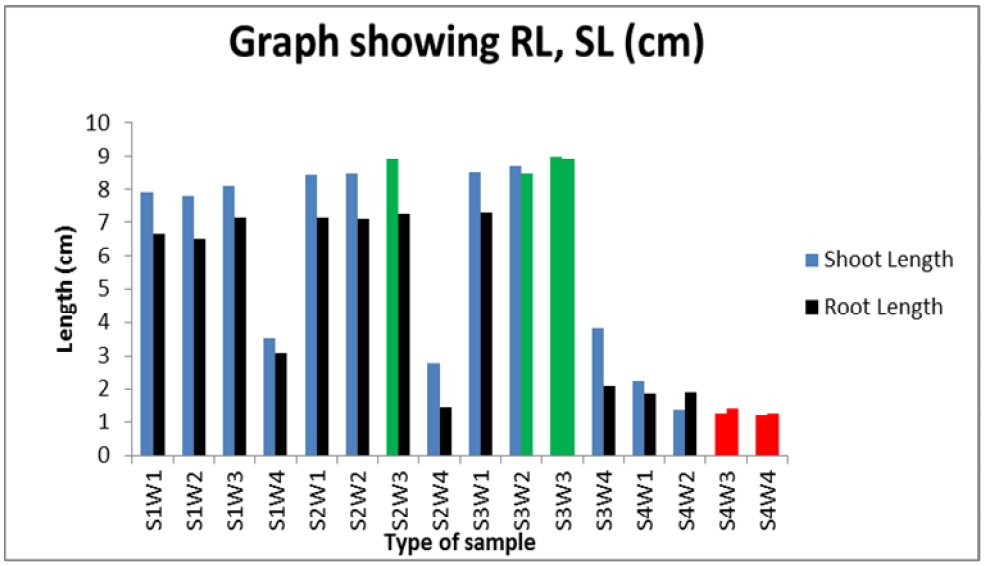

Fig. 1: Comparative analysis of Shoot length and Root Length of various wheat samples with different treatments after 10 DAS

Table 2: Fresh weight, Dry weight, and moisture content of wheat samples under various treatment conditions (Mean±SD of six values)

Samples	Fresh Weight (g)	Dry Weight (g)	Moisture Content (%)
S1W1	0.82±0.024	0.19±0.02	0.63±1.77
S1W2	0.8±0.021	0.15±0.12	0.65±1.23
S1W3	0.93±0.024	0.2±0.012	0.73±1.26
S1W4	0.47±0.033	0.09±0.011	0.38±1.19
S2W1	0.72±0.02	0.21±0.014	0.51±1.77
S2W2	0.79±0.014	0.15±0.0136	0.64±1.74
S2W3	0.81±0.015	0.17±0.0123	0.64±1.29
S2W4	0.46±0.014	0.09±0.008	0.37±1.42
S3W1	0.95±0.02	0.25±0.011	0.7±1.57
S3W2	0.99±0.017	0.3±0.01	0.69±1.098
S3W3	1.05±0.035	0.32±0.011	0.73±1.59
S3W4	0.45±0.014	0.15±0.012	0.3±2.66
S4W1	0.4±0.028	0.14±0.007	0.26±0.86
S4W2	0.36±0.035	0.11±0.012	0.25±1.83
S4W3	0.21±0.021	0.05±0.01	0.16±1.25
S4W4	0.19±0.024	0.02±0.02	0.17±1.86

Total Leaf Area:

The leaf area of the leaves was determined and was calculated on 30, 60 and 90 DAS of the experiment. The values of L, W and LA are tabulated in Table 3 and also represented by Figure 5, Figure 6 and Figure 7.

It is clearly shown in Figure 5, Figure 6 and Figure 7 that higher concentration of sugar mill effluents cause decrease in leaf length, width and leaf area after 30 DAS, 60 DAS and 90 DAS whereas low concentration has stimulating effect on these factors. So it is quite clear that using low concentration of effluents in crops for irrigation purpose is beneficial for good growth of plant leaf and also increasing photosynthesis rate and hence crop production. Positive effect on crops is indicated by green line in the figure and negative effect by red line. In all the figures S4W4 and S2W4 generally are having least values and S2W2/S3W2 is having highest growth of leaf length, width and area after 30 DAS, 60 DAS and 90 DAS.

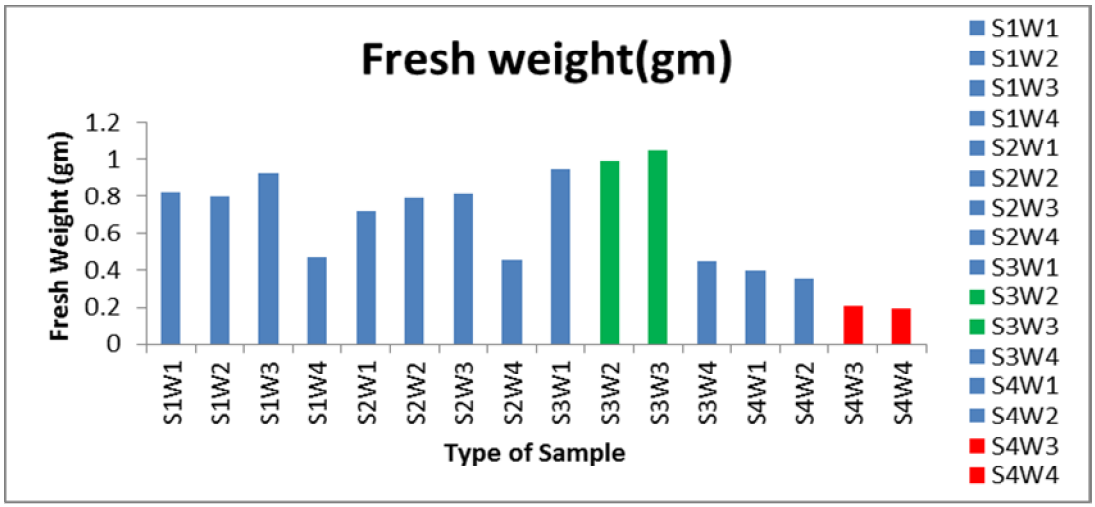

Fig. 2: Comparative analysis of fresh weight of wheat samples under various treatment conditions after 10 DAS

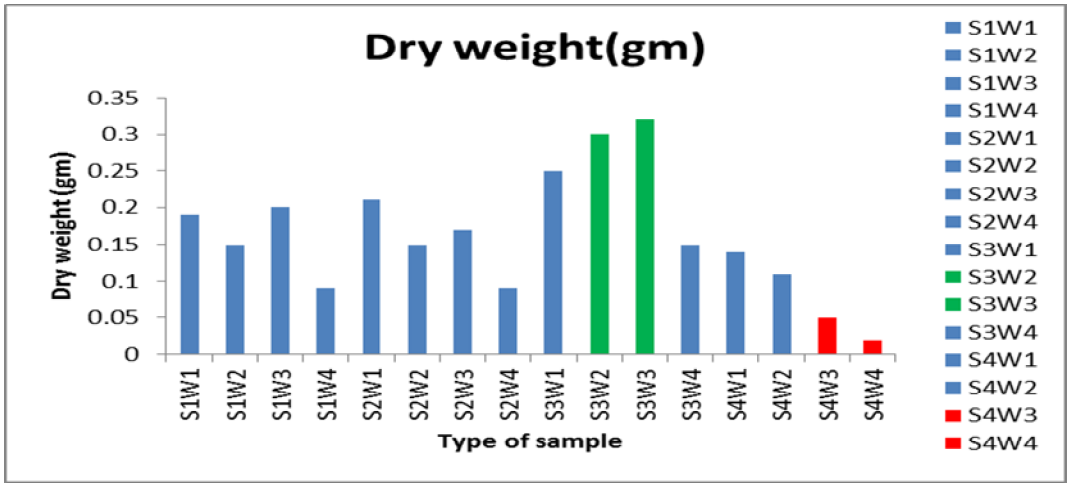

Fig. 3: Comparative analysis of dry weight of various samples under different treatment conditions after 10 DAS

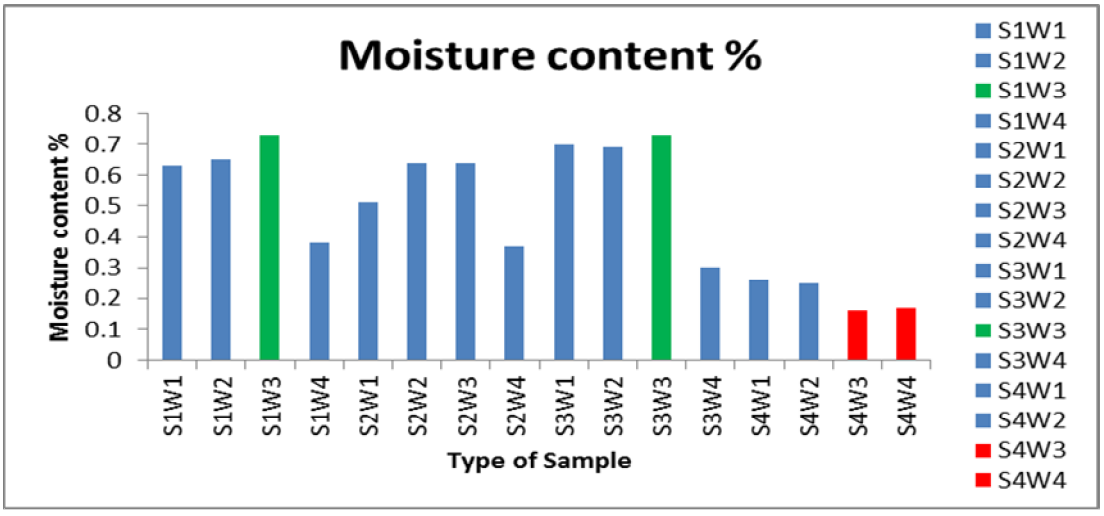

Fig. 4: Comparative analysis of moisture content in percentage of various samples under different treatment conditions after 10 DAS

Table 3: Leaf length, leaf width and leaf area of leaves of various samples under different treatment conditions after 30, 60 and 90 DAS (Mean±SD of ten values)

Samples	30 DAS			60 DAS			90 DAS		
	Leaf Length	Leaf Width	Leaf Area	Leaf Length	Leaf Width	Leaf Area	Leaf Length	Leaf Width	Leaf Area
S1W1	9.5±0.67	0.5±0.019	3.56±0.23	14.3±0.37	1.2±0.022	12.87±0.45	18.5±0.67	1.7±0.02	23.58±1.67
S1W2	9.32±0.19	0.5±0.02	3.49±0.41	13.12±0.13	0.98±0.009	9.64±0.43	16±0.22	1.5±0.023	18±1.11
S1W3	8.66±0.15	0.53±0.01	3.44±0.34	13.06±0.12	1.15±0.012	11.26±0.43	15.66±0.17	1.73±0.019	20.33±1.17
S1W4	7.63±0.13	0.32±0.007	1.83±0.26	11.33±0.18	0.91±0.01	7.73±0.34	13.83±0.12	1.22±0.032	12.66±1.34
S2W1	8.5±0.21	0.35±0.02	2.23±0.33	11.95±0.22	0.92±0.008	8.24±0.23	15.5±0.3	1.34±0.12	15.58±1.11
S2W2	8.66±0.16	0.42±0.001	2.72±0.28	14.66±0.26	1.05±0.02	11.54±0.54	19.66±0.3	1.42±0.021	20.94±1.34
S2W3	9.33±0.11	0.61±0.02	4.26±0.36	13.53±0.21	1.42±0.01	14.41±0.52	16.33±0.31	1.67±0.16	20.45±1.42
S2W4	6.93±0.04	0.38±0.001	1.97±0.12	10.63±0.03	0.81±0.01	6.46±0.34	13.83±0.06	1.11±0.012	15.35±1.65
S3W1	8.66±0.13	0.38±0.005	2.46±0.17	11.76±0.14	0.88±0.002	7.76±0.26	15.66±0.23	1.38±0.025	21.62±1.26
S3W2	9.5±0.11	0.56±0.001	3.99±0.46	14.5±0.25	1.18±0.04	12.83±0.48	18.5±0.16	1.76±0.031	32.56±1.34
S3W3	9.83±0.12	0.59±0.001	4.34±0.51	13.53±0.2	1.16±0.001	11.77±0.45	16.83±0.32	1.79±0.01	30.13±1.31
S3W4	6.66±0.13	0.46±0.015	2.3±0.14	11.06±0.12	0.89±0.003	7.38±0.33	15.66±0.23	1.16±0.15	18.17±1.42
S4W1	8.83±0.17	0.43±0.013	2.84±0.16	11.88±0.16	0.76±0.015	6.77±0.22	16.83±27	1.23±0.03	20.70±1.26
S4W2	8.83±0.14	0.48±0.002	3.17±0.31	15.33±0.24	0.91±0.013	10.46±0.31	18.83±0.27	1.52±0.02	28.62±1.37
S4W3	9.16±0.12	0.57±0.008	3.19±0.17	13.86±0.11`	1.03±0.002	10.7±0.22	17.16±0.12	1.67±0.018	28.66±1.15
S4W4	6.33±0.14	0.31±0.001	1.47±0.11	9.96±0.15	0.69±0.008	5.15±0.34	12.33±0.34	1.1±0.011	13.56±1.82

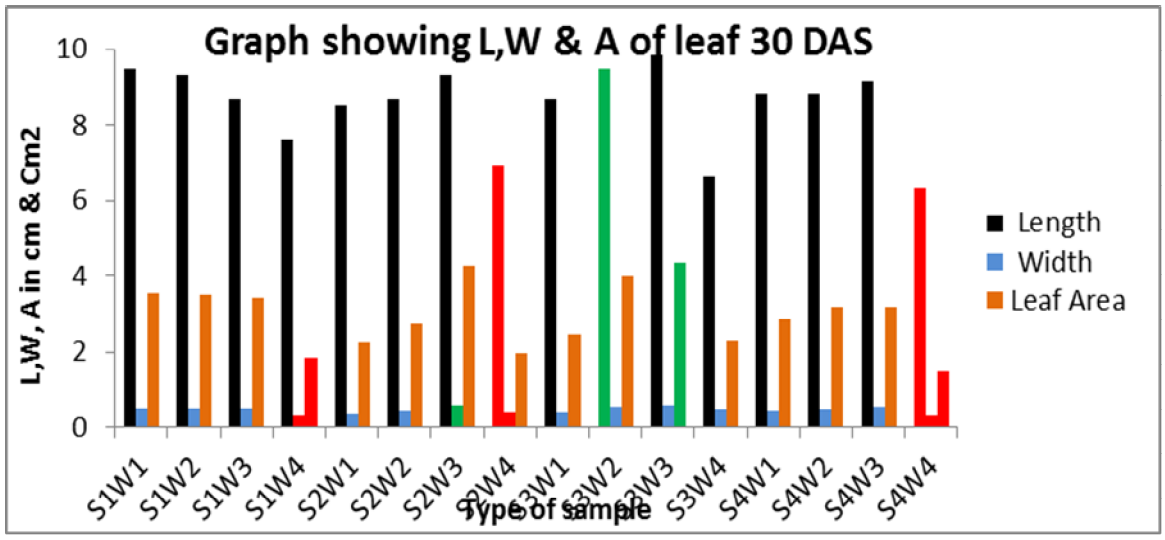

Fig. 5: Comparative analysis of length, width and area of leaf of various wheat samples with different treatments after 30 DAS

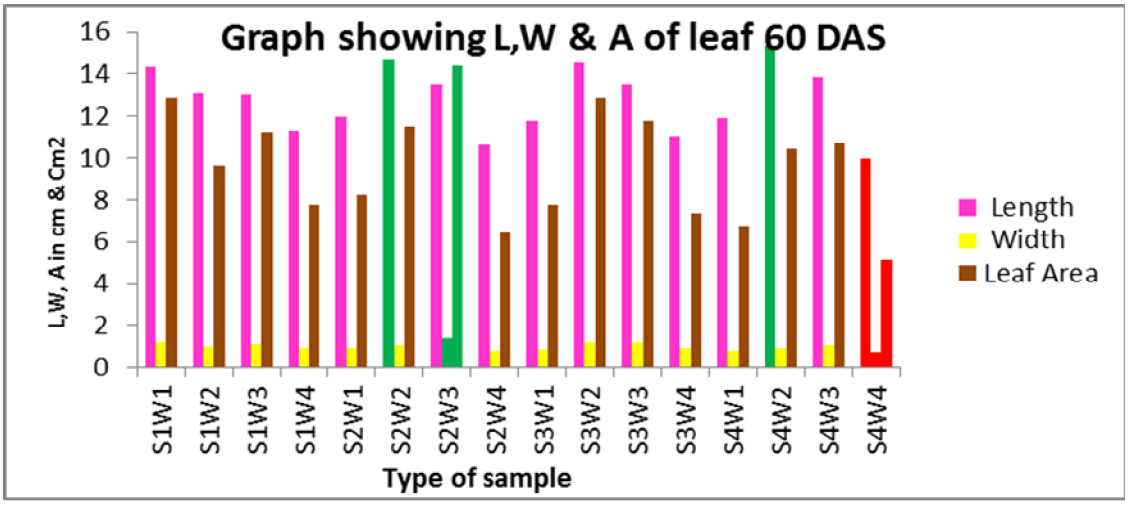

Fig. 6: Comparative analysis of length, width and area of leaf of various wheat samples with different treatments after 60 DAS

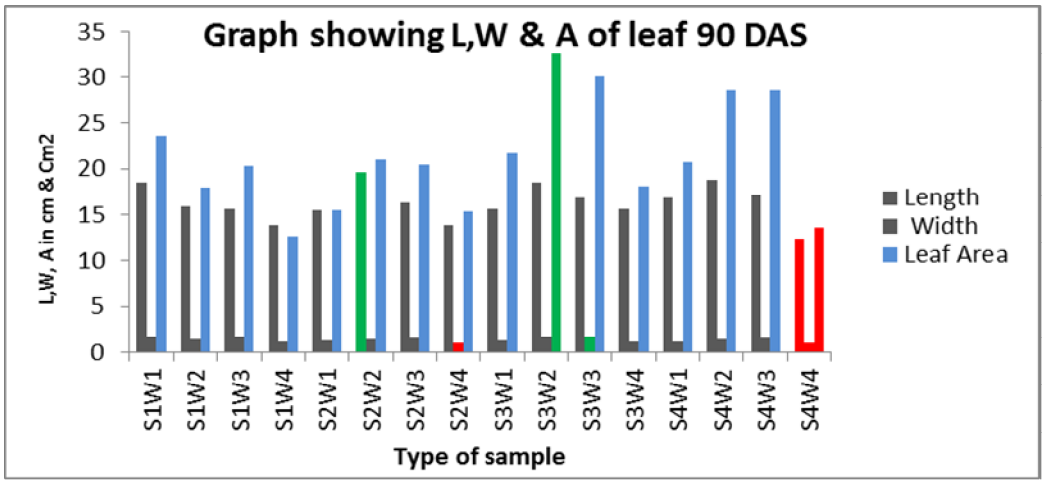

Fig. 7: analysis of length, width and area of leaf of various wheat samples with different treatments after 90 DAS

CONCLUSION

Morphological parameters of wheat like root length, shoot length, fresh weight, dry weight etc. are reducing with the increase in effluent concentration but showed good growth at low concentration up to 50 per cent concentration of effluents. Samples with 100 per cent concentration of SME showed almost negligible growth of various parameters. So it has been noticed that effluent concentration is beneficial up to value of 50 per cent and after this concentration there is reduction in various parameters of the wheat crop. Hence sugar mill effluents with 50 per cent concentration can be used for crops.

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