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ORIGINAL ARTICLE

Impact of Concentration of Sugar Mill Effluents on Germination Parameters of Wheat Crop (*Triticum aestivum* L.)

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ABSTRACT

Use of sugar mill effluents for irrigation is in practice these days throughout the world due to inadequacy of water internationally. This research paper aims to study the effect of different concentration of sugar mill effluents (0, 25, 50 and 100%) on germination parameters of wheat crop. It has been found that after appropriate dilution sugar mill effluents can be used for irrigation.

Key words: *concentration, germination, sugar mill effluents*

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INTRODUCTION

The water quality for irrigation purpose is indispensable for maintaining quality of crops. Therefore quality of water used for irrigation is the most important parameter for any crop. Chemical characteristics of water and soil are essential parameters to assess the germination of a crop.

STUDY AREA

The present research is about the impact of concentration or dilution of sugar mill effluents on germination parameters of wheat crop. 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 germination of wheat crop.

MATERIALS AND METHODS

Experiment was performed from November 2015 to April 2016. Experimental pots of 50 X 50 cm^2 in triplicates were used. Thus, there were 16 experimental conditions in triplicate mode including 48 pots as shown in Table 1. Seeds of Wheat (*Triticum aestivum* L.) were purchased from market. The experimental pots were ploughed thoroughly before sowing, filled with field soil and irrigated with different concentrations (0 %, 25 %, 50 % and 100 %) of sugar mill effluents for seven days before sowing. The seeds of wheat were sown in different pots in number of fifteen in each. Same concentration (0 %, 25 %, 50 % and 100 %) of sugar mill effluents was used for both water used for irrigation and soil

used in pots. The seeds irrigated with BWW (Bore Well Water) were treated as control (S1W1) and all pots were examined regularly for germination of seeds at an interval of 24 h (Pandey, 2007, Siva and Suja, 2012). First irrigation was done to all pots with blank water and then with different concentrations of sugar mill effluents for seven days before sowing.

Table 1: Experiment layout for irrigation of pot soil to study sugar mill effluent impact on wheat growth

Water / Soil	Blank water (1: 0)	Wastewater with dilution ratio (1:3)	Wastewater with dilution ratio (1:1)	Wastewater with dilution ratio (0:1)
Soil irrigated with blank water	S1W1 (100 %)	S1W2	S1W3	S1W4
Soil irrigated with wastewater with dilution	S2W1	S2W2	S2W3	S2W4
Soil irrigated with wastewater with dilution	S3W1	S3W2	S3W3	S3W4
Soil irrigated with undiluted wastewater	S4W1	S4W2	S4W3	S4W4 (100 %)

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)

The different concentrations (0 %, 25 %, 50 % and 100 %) of sugar mill effluents were prepared with tap water. All the pots were irrigated in equal volume twice a week till the harvest stage. Pots were regularly monitored for seed germination and various parameters were determined using the formulae given by Czabater (1962) which are explained below.

Germination Percentage:
The germination percentage was calculated by the following formula:

$$\text{Percentage Germination} = \frac{\text{Total number of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

Speed of Germination:
Maguire (1962) method was used for estimation of speed of Germination:

$$\text{Speed of Germination} = \text{No. of seeds germinated/Days of first count} + \ldots\ldots + \text{No. of seeds germinated/Days of final count}$$

Peak Value:
Peak day may be defined as the day on which maximum germination of seeds occur. It is defined as the Cumulative percentage germination on each day/No. of days elapsed since initial inhibition.

Vigour Index:
This is calculated by determining the germination percentage and seedling length in mm of the same seed lot. Vigour index of the seedlings were calculated by using the formula proposed by Abdul-Baki and Anderson (1973). The seeds showing higher seed vigour index are considered to be more vigorous (Abdul-Baki and Anderson, 1973).

$$\text{Vigour index} = \text{Germination percentage} \times \text{Seedling length (mm)}$$

RESULT AND DISCUSSION

Parameters analysed included germination percentage, speed of germination, peak value, vigour index and number of roots in seedlings.

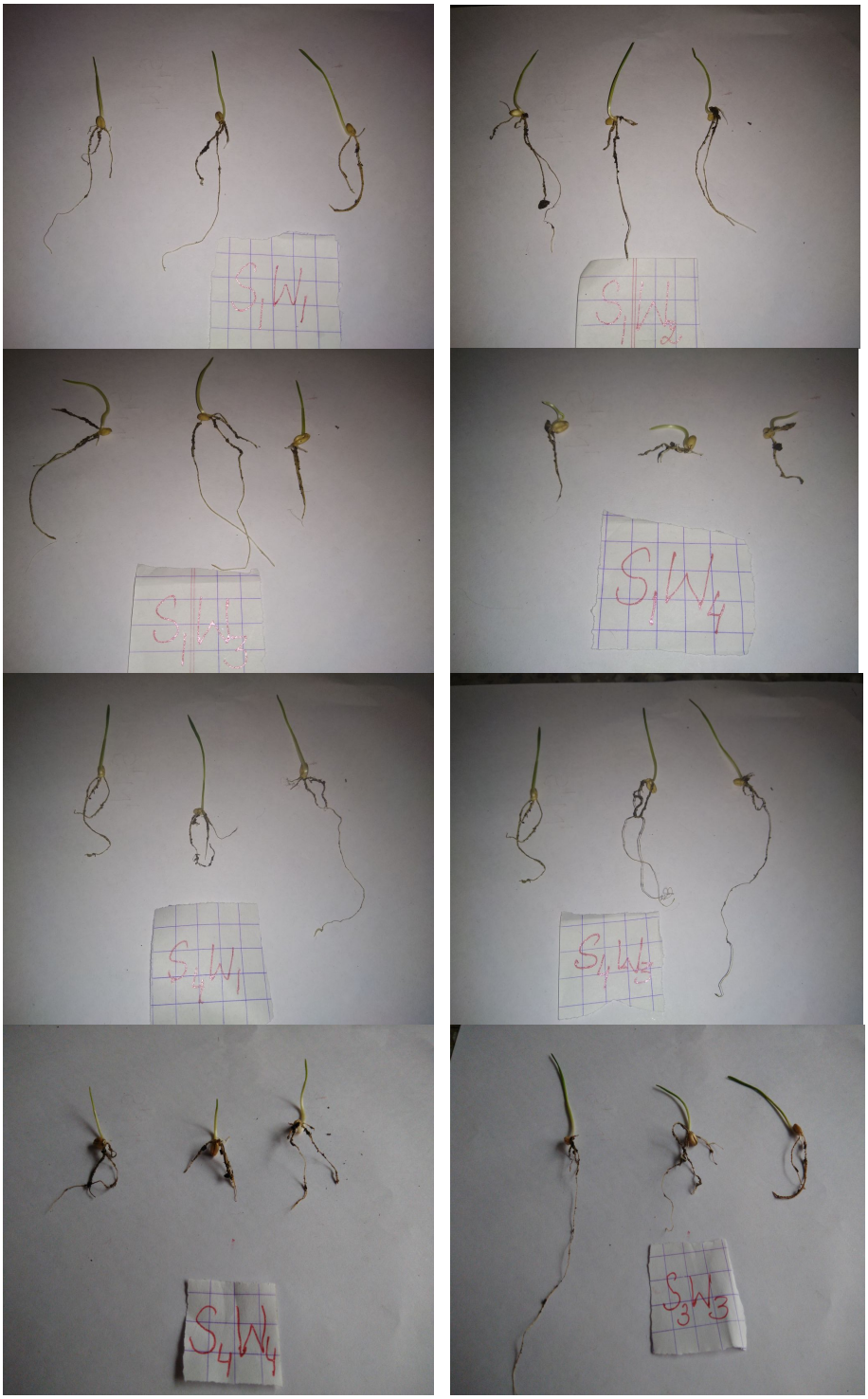

Fig. 1: Germination pattern of wheat plant irrigated with different concentrations (0 %, 25 %, 50 % and 100 %) of sugar mill effluents

Germination of Seeds:
Wheat seeds were sown in experimental pots as mentioned under material and methods. The pattern of germination was noted after ten days by carefully pulling out the seedlings from each pot and the numbers of roots were also counted in the seedlings. Seedling pattern of root growth and shoot growth is shown for some samples given in Figure 1

Table 2: Germination parameters of various wheat samples with different concentrations (0 %, 25 %, 50 % and 100 %) of sugar mill effluents
(Mean±SD of three values)

Samples	Germination (%)	Speed of Germination	peak value
S1W1	84.7±3.85	7.21±0.85	8.66±0.57
S1W2	85.43±3.85	7.58±0.75	9.33±0.58
S1W3	93.66±6.67	8.21±0.57	8.33±0.57
S1W4	21.10±3.85	2.16±0.35	7.66±0.57
S2W1	84.86±0.00	7.98±0.45	7.66±0.58
S2W2	89.91±6.67	8.54±0.52	7.33±0.58
S2W3	94.44±3.85	9.21±0.63	8.33±0.57
S2W4	24.576±3.85	2.11±0.28	7.33±0.58
S3W1	87.77±3.85	7.59±0.42	8.33±0.57
S3W2	89.2±3.85	7.23±0.42	9.33±0.57
S3W3	95.44±3.85	9.34±0.27	8.66±0.58
S3W4	23.66±0.00	1.89±0.72	7.66±0.57
S4W1	21.66±3.85	1.21±0.46	9±1
S4W2	20.98±3.85	1.29±0.28	7.66±1.15
S4W3	11.1±3.85	1.01±0.52	7.33±0.57
S4W4	10.99±3.85	1.11±0.41	7.33±0.57

Germination Percentage:
With increase in effluent concentration, there is reduction in germination percentage of the wheat seeds but showed good germination rate at 25 % concentration and at up to 50 per cent concentration of effluents showed germination even better than with control. Table 2 showed germination rate of wheat under different treatment conditions. Samples with 100 per cent concentration of SME showed almost negligible germination which is marked by red line in graph shown in Figure 2 and green line represents highest value of these parameters indicating usefulness of diluted SME in agriculture for better yield of crops.
This finding has further been supported by Tayyar and Yapict, 2009; Gaikar, *et al*., 2010; Kalaiselvi, *et al.* 2010; Suresh, *et al*., 2014; and Raju, *et al.,* 2015. The seeds germinated were noted on each and every day after sowing and then the percentage of germination was calculated by the formula as given. Although the seeds germinated in the samples containing S4W4 showed least germination even at a later stage as compared to the pots irrigated with diluted effluents and containing soil prepared by irrigating with diluted effluents but still the number of seeds germinated were counted on each and every day and represented in tabular form. Table 2 shows the percentage of germination of various samples and their comparison is shown in Figure 2.

Speed of Germination:
A comparative account of speed of germination of various wheat samples containing different ratio of sugar mill effluents is given in Figure 3. It has been shown clearly by the values given in Table 2, and indicated that speed of germination was maximum for samples S3W3 and S2W3 *i.e.* effluent concentration is beneficial upto value of 50 per cent and after this concentration there is reduction in germination speed of the wheat crop. The comparative seed germination is shown in Figure 3 which represents maximum speed in green lines and minimum is indicated by red lines showing inhibitory effect of effluents.

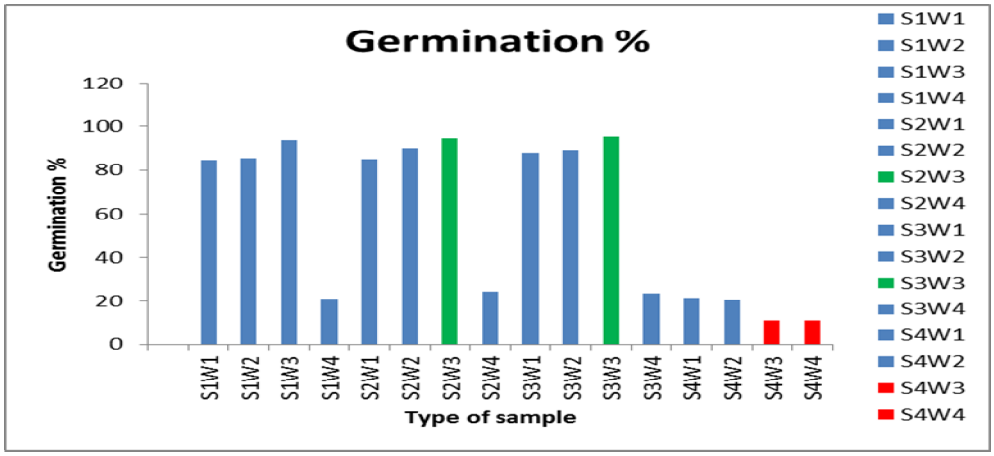

Fig. 2: Graph showing percentage of seed germination of various samples of wheat under different treatment conditions

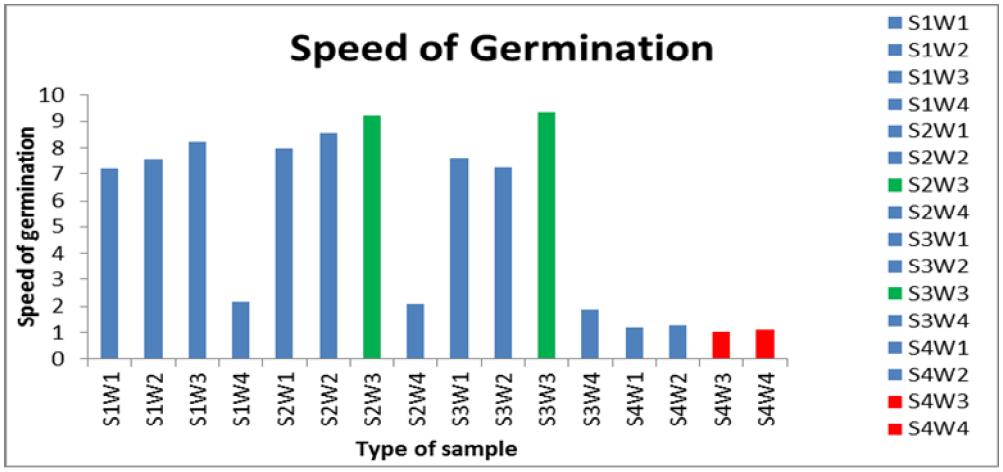

Fig. 3: Graph showing speed/rate (%) of wheat germination of various samples of wheat under different treatment conditions

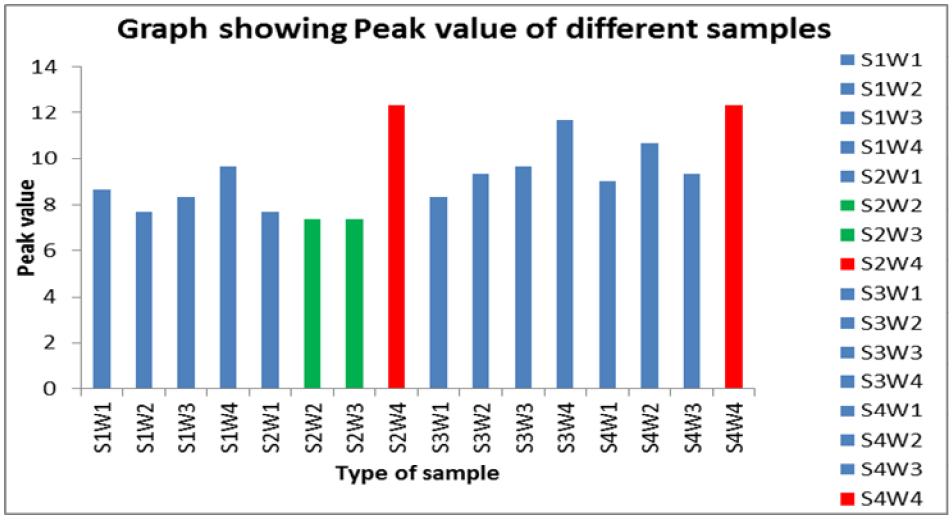

Fig. 4: Peak values of wheat germination under various treatment conditions

Table 3: Vigour Index and number of Roots of various samples of different effluent concentrations (Mean±SD of six values)

Samples	Number of Roots	Vigour Index
S1W1	3.33±0.57	12340.7±487.14
S1W2	4.33±0.57	12233.5±475.33
S1W3	4.33±0.57	14255.0±890.66
S1W4	1.66±0.5	1392.6±44.9
S2W1	4±0.5	13178.7±580
S2W2	5.33±0.57	13981.0±914.77
S2W3	5.66±0.57	15270.9±534.41
S2W4	2.33±0.5	1037.1±47.48
S3W1	4.66±0.57	13850.1±529.24
S3W2	5.33±0.57	15306.7±537.68
S3W3	5.66±0.57	17093.3±553.95
S3W4	1.33±0.57	1395.9±123.12
S4W1	1.33±0.57	881.5±78.47
S4W2	1.66±0.57	692.3±84.76
S4W3	1.33±0.5	299.7±66.85
S4W4	0.66±0.57	268.1±22.88

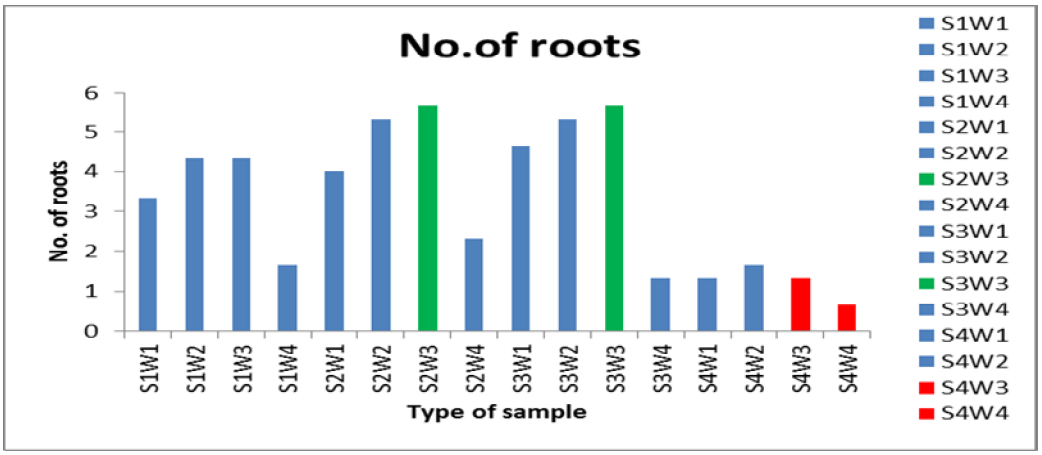

Fig. 5: Comparative analysis of Number of roots of various wheat samples with different treatments after 10 DAS

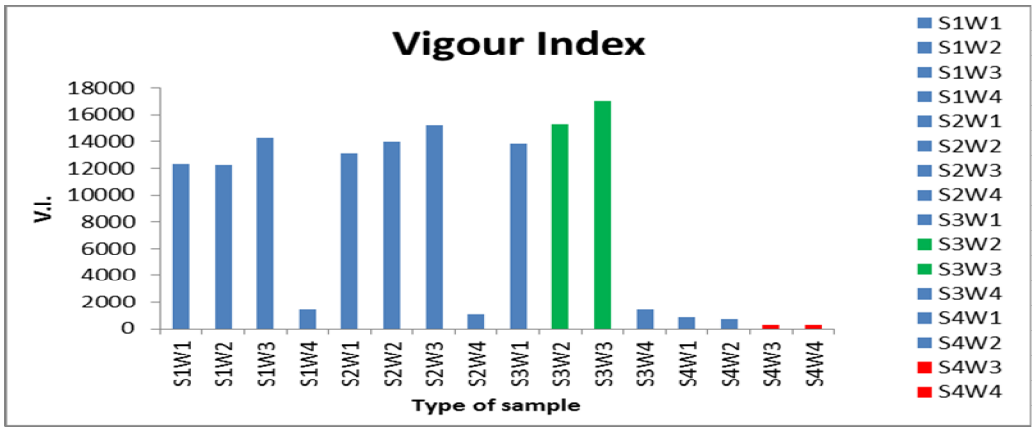

Fig. 6: Comparative analysis of vigour index of wheat samples under various treatment conditions

Peak Value:
The peak values of seed germination under various treatment conditions of different effluent concentrations are given in Table 2 and their comparison in Figure 4 and it was noticed that it is lowest for S2W4 and S4W4 and highest for S2W3 and S2W2 which gives us the idea that effluent with low concentration upto 50 per cent are suitable for better growth of the crops.

Number of Roots:
A mature wheat plant has two distinct root types. The seminal roots are the first root types and nodal roots appear thereafter. The seminal roots are formed from the seed and nodal roots from the nodes and are related with the growth of tillers. Numbers of roots in seedlings after ten days are given in Table 3. The number of roots in various samples of different effluent concentrations are compared and shown in Figure 5. It had been found that number of roots of seedlings were maximum for S3W3& S2W3 and minimum for S4W4 & S4W3 respectively when compared with different treatment conditions.

Vigour Index:
The vigour index value of various samples of wheat is determined by the formula given above. Figure 6 represents the vigour index of different samples. It is clearly shown in graph that this value is lowest for S4W3 and S4W4 and highest for S3W2 and S3W3 which confirms that effluent with low concentration upto 50 per cent are suitable for good vigour crops.

CONCLUSION

Germination percentage and Speed/rate of germination of the wheat seeds are reducing with the increase in effluent concentration but showed good germination rate at low concentration and at up to 50 per cent concentration of effluents showed germination even better than with control. Samples with 100 per cent concentration of SME showed almost negligible germination. 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 germination speed of the wheat crop.

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