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Impact of Sugar Factory Wastewater on Chlorophyll Content, Carbohydrate and Biomass Production of *Triticum aestivum* Var. Malvia-212

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ABSTRACT

Total and individual chlorophylls, *a* and *b*, total water soluble carbohydrates and dry weight of *Triticum aestivum* var. Malvia-212 were determined following the treatment with different concentrations of the sugar factory wastewater. Concentrated effluents showed marked effect and reduced these contents significantly which may be attributed to the reduced number of leaves and leaf area. The reduced growth and biomass are result of high concentration of soluble salts and heavy metals present therein, which possibly interfere with the absorption of water and minerals.

INTRODUCTION

Industrial effluents in this region of Uttar Pradesh are often released in unplanned manner in water bodies. Presence of heavy metals and high concentration of soluble salts in the industrial wastewaters have been reported by several workers (Tripathi 1975, Purner & Seigal 1972, Jain 1981 and Bagchim 1976). Studies on adverse effect of the effluents on growth, biomass, chlorophyll content and metabolism have been made by several workers (Sahai & Singh 197, Benergi & Kumar 1979, Singh & Srivastava 1984).

Wheat is a major crop of this region and its irrigation is managed from different water bodies. Since chlorophyll is directly concerned with photosynthetic carbohydrate and biomass production, losses incurred are quite significant. In view of its importance, the present work has been undertaken.

MATERIALS AND METHODS

Seeds of the variety Malvia-212 of wheat (*Triticum aestivum*) were sown in earthen pots containing garden loam soil mixed with dung. The soil was moistened by adding one litre of sugar mill waste of different concentrations (25, 50, 75 and 100 per cent) on alternate day. Three replicates were maintained for each set of experiment. Seeds were allowed to germinate under normal environmental conditions.

Various growth parameters *viz.*, dry weight, number of leaves produced and leaf area were recorded, and chlorophyll content and water soluble carbohydrates were determined at different time intervals. A control set was also run for each treatment to standardise the results. For control experiment, one litre distilled water was used to moist the soil.

Chlorophyll: Chlorophylls were estimated after 60 days after sowing as per method of Arnon (1949). The amount was determined by applying the formula given below and expressed as milligrams of chlorophyll per gramme of fresh leaf.

mg Total Chl./g of fresh leaf = D 652 × V/34.5 × W

D = OD at 652 nm
V = Final volume of 80% acetone extract
W = Fresh weight of leaves

Total water soluble carbohydrates: The water soluble carbohydrate content was determined as per method of Dubois et al. (1951) and calculated using standard curve prepared from starch and glucose and expressed as percent on dry weight basis.

RESULTS AND DISCUSSION

Number of leaves: Effluents of sugar mill has significantly reduced the number of leaves over control. The maximum effect was visible in 100 and 75 per cent of the effluent. However, effluent diluted up to 25% when given to the plants produced leaves nearly equal to the control plants (Table 1).

Leaf area: Total leaf area determined in the treated plants was much lower in comparison to control plants. The inhibition was more pronounced in 75 and 100 percent (undiluted) effluents (Table 2).

Dry weight: Maximum loss in dry matter was found in plants treated with 100 percent followed by 75 percent of the effluent. However, much diluted sugar mill effluent (25%) was not effective and dry weight was almost equal to control plants (Table 3).

Chlorophyll content: The plants treated with 25, 50, 75 and 100 percent of sugar mill effluent have 1.30, 1.27, 1.20 and 1.12 mg/g Chl-*a* and 1.79, 1.60, 1.47 and 1.37 mg/g Chl-*b* respectively after 60 days whereas in untreated (control) plants amount of Chl-*a* and Chl-*b* was 1.36 and 1.85 mg/g respectively (Table 4). Similarly, plants treated with same concentrations of the effluent and analysed after 135 days contained lesser chlorophyll contents than control plants (Table 4).

Water soluble carbohydrate: Plants treated with 25, 50, 75 and 100 per cent of sugar mill effluent contained 4.00, 3.48, 3.14 and 2.00 per cent water soluble carbohydrate respectively after 60 days whereas in control plants it was 4.00 percent. Effluents above 25% reduced the water soluble carbohydrates in treated plants over control (Table 5).

Sahai & Singh (1977), Benergi & Kumar (1979) and Singh & Srivastava (1984) have reported adverse effect of the effluents on growth, biomass, chlorophyll content and metabolism. Agrawal et al. (1961) suggested that heavy metals can inhibit chlorophyll formation by preventing magnesium uptake.

Table 1: Number of leaves produced per plant *of wheat* treated with different concentrations of sugar mill effluent.

Days after sowing	Control	Concentrations (%) 25	50	75	100	C.D. at 5%	C.V.	S.Em
10	3.67	3.33	2.00	2.00	1.67	0.81	10.17	0.26
15	4.00	2.67	2.33	2.33	2.00	0.81	17.78	0.26
20	4.67	3.00	2.67	2.67	2.00	0.81	14.91	0.26
25	5.00	3.00	3.33	3.33	2.33	0.94	14.90	0.30
30	5,33	3.67	3.33	3.33	2.67	1.05	15.47	0.33
35	6.00	4.33	4.00	3.67	3.67	0.81	10.32	0.26
40	6.67	5.33	4.33	4.00	4.33	1.24	13.85	0.39

Values significant

In the present study the dry weight, leaf number and total leaf area have been reduced by the higher (above 25%) concentrations of the sugar mill wastewater. Further, chlorophylls *a* and *b*, and total soluble carbohydrates have also been reduced significantly by the same concentrations.

It is suggested, therefore, that higher concentrations of soluble salts and presence of heavy metals even above tolerance level in the sugar mill wastewater, interfere with the absorption of water

Table 2: Total leaf area (cm^2) per plant of *Triticum aestivum* var. Malvia-212 treated with different concentrations of sugar mill effluent.

Days after sowing	Control	Concentrations (%) 25	50	75	100	C.D. at 5%	C.V.	S.Em
60	195.88	165.78	165.78	105.22	85.67	8.33	3.33	2.65
75	348.99	311.18	276.18	246.60	212.62	11.40	2.25	3.62
90	565.56	485.92	262.23	250.60	239.82	56.04	8.06	17.70
105	597.12	456.79	393.70	279.95	247.73	103.88	14.94	32.97
120	683.84	616.93	539.33	460.99	402.30	9.84	1.00	3.12
135	690.00	620.00	542.00	465.00	408.22	15.33	1.86	4.86

Values significant

Table 3: Dry weight (g) per plant (whole plant) of *Triticum aestivum* var. Malvia-212 treated with different concentrations of sugar mill effluent.

Days after sowing	Control	Concentrations (%) 25	50	75	100	C.D. at 5%	C.V.	S.Em
60	1.53	1.47	1.04	0.95	0.81	0.07	3.53	0.02
75	3.32	3.17	2.85	2.47	2.00	0.14	2.83	0.04
90	5.76	5.69	5.04	4.00	3.30	1.41	15.59	0.45
105	11.91	11.75	9.42	8.17	7.25	0.28	1.61	0.09
120	22.04	21.85	18.86	14.59	12.43	2.08	6.37	0.66
135	27.90	24.93	22.25	18.39	14.19	0.75	1.91	0.24

Values significant

Table 4: Chlorophyll content (mg/g of fresh weight) in leaves of *Triticum aestivum* var. Malvia-212 treated with different concentrations of sugar mill effluent.

Days after Treatment	Chlorophylls	Control	Concentrations (%) 25	50	75	100
60	Chlorophyll-*a*	1.36	1.30	1.27	1.20	1.12
	Chlorophyll-*b*	1.85	1.79	1.60	1.45	1.37
135	Chlorophyll-*a*	2.10	1.50	1.35	1.35	1.33
	Chlorophyll-*b*	2.80	1.39	1.80	1.50	1.49

Table 5: Percent soluble carbohydrate in *Triticum aestivum* van Malvia-212 treated with sugar mill effluent.

Days after Treatment	Control	Concentrations (%) 25	50	75	100
60	4.00	4.00	3.48	3.14	2.00
135	5.50	5.50	3.00	2.90	1.65

and minerals including magnesium uptake from the soil resulting in growth inhibition and low chlorophyll content. Since, chlorophylls are directly concerned with photo- synthetic carbohydrate synthesis, the reduction in water soluble carbohydrates may be attributed to the reduced number of leaves, total leaf area and chlorophyll content. Consequently, the cell material and the biomass have also been reduced.

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