Impact of Textile Industry Effluent on Chlorophyll and Nutrient Content in Tomato

SHAKUNTALA GIRI[1], R.P. SINGH[2]

Department of Botany, S. N. P. G. College, Azamgarh, U.P., India
[2]Department of Ag. Chemistry and Soil Science, Udai Pratap (Autonomous) College, Varanasi, U.P., India

ABSTRACT

The components generally present in textile industry effluents cause damage to water bodies, when untreated effluents are discharged into it. The aim of the present study is to observe impact of textile industry effluent on chlorophyll and nutrient content in tomato. Effluent of textile industry was procured from district Bhadohi and used in this study. A pot experiment was conducted adopting Completely Randomized Design with five treatments and three replications in the natural open weather conditions for 60 days during the plant season. Five concentrations viz; 0%, 25%, 50%, 75% and 100% were used for present experiment. Zero per cent concentration was treated as control. Observations related to chlorophyll and nutrient content (carbohydrate, nitrogen and protein) were recorded at different days after transplanting. Results indicate that chlorophyll and nutrient content gradually decreased with increase in effluent concentrations and the maximum amount was found at 0% concentration level whereas minimum was with 100% concentration.

Keywords: *Textile effluent, Tomato, Chlorophyll, Carbohydrate, Nitrogen and Protein content.*

INTRODUCTION

Effluents when discharged as (untreated or partially treated) into the water bodies, adversely affect aquatic ecosystem by reducing the penetration power of sunlight and ultimately reduces the photosynthetic activities and dissolved oxygen content. But in agricultural soil it causes inhibition of seed germination by reducing soil alkalinity and manganese availability. These effluents contain heavy metals as well as nutrients, which affect plant and soil in different ways. Most of the studies conducted to investigate the effects of different industrial effluents on vegetable crops and cereals. Hence, wastewater requires pretreatment before its safe disposal into the environment.

Impact of industry effluent on cultivated land and chlorophyll a and b [1] and observed that enhanced with increasing the effluent concentration till 50%, whereas, reduced at more concentrated effluent. [2] Studied the influence of wastewater of paper mill on germination, growth of seedling and pigment content of *Hordeum vulgare* and observed a decline in percent germination only at higher concentration of the effluent.

[3] Effluents, which are normally toxic to plants in pure form, could be favorably used for irrigation purpose after proper dilution and served as an additional potential source of required fertilizer. Fertilizer factory effluent was highly alkaline, rich in total solids, calcium chloride, bicarbonate and total nitrogen. It can be used for irrigation purpose after proper dilution. [4] The chlorophyll a and chlorophyll b contents increased at 6.25% concentration and decreased significantly at higher concentrations of effluent.

In this present study, effort has been made to observe the impact of textile industry effluent on chlorophyll and nutrient content in tomato.

MATERIALS AND METHODS

For present study, textile industry effluents containing municipal sewage were collected from Ghosia town of district Sant Ravidas Nagar, Bhadohi. This district is situated in Latitudes 25˚23' north and Longitudes 82˚34' East at the distance about thirty miles from west of Varanasi.

To find out the impact of textile industry effluent on chlorophyll and nutrient content in tomato, a pot experiment was conducted adopting Completely Randomized Design with five treatments and three replications in the natural open weather conditions for 60 days during the plant season. Pots were filled with normal soil without any effluent treatment. The seedling of tomato (*Solanum lycopersicum* L.) was obtained from Indian Institute of Vegetable Research (IIVR), Varanasi. Seedling was transplanted in the pots. Five concentrations of effluent viz; 0%, 25%, 50%, 75% and 100% were used for present experiment. Zero per cent concentration was treated as control. All the pots were uniformly watered with distilled water whenever required. In treated pots, effluent of various concentrations was given at the interval of 15 days. The data pertaining to chlorophyll and nutrient content were recorded after 30, 45 and 60 days after transplanting.

Chlorophyll content

The chlorophyll content was estimated [5].

250 mg of fresh leaves, cut out in small pieces, were crushed with 10 ml of 80% acetone in a clean mortar. The content were centrifuged at 10000 rpm for 10 min. The clear supernatant was separated and the procedure repeated with the residue for complete extraction. The volume of the pooled supernatant was raised to 25 ml with 80% acetone. The optical density of the chlorophyll extract was read in a spectrocolorimeter at 645, 652 and 663 nm respectively using 80% acetone as blank. The amount of chlorophyll (a, b and total) present in the extract was calculated in terms of milligrams of chlorophyll per gram of leaf tissue extracted as per following equations:

$$\text{Chlorophyll a (mg/g)} = 12.7(\text{OD } 663) – 2.69(\text{OD } 645) \times \frac{V}{1000 \times W}$$

$$\text{Chlorophyll b (mg/g)} = 22.9(\text{OD } 645) - 4.68(\text{OD } 663) \times \frac{V}{1000 \times W}$$

$$\text{Total Chlorophyll (mg/g)} = 20.0(\text{OD } 645) + 8.02(\text{OD } 663) \times \frac{V}{1000 \times W}$$

Where,

OD = Optical density obtained of the extract at the wave lengths specified,

V = The final volume of the extract

W = Fresh weight in grams of the tissue extracted.

Carbohydrate

The carbohydrate of fruit was estimated [6]. These are briefly described below:

On a clean sheet of paper sufficient amount of fruit powder was spread and dried overnight in an oven at 80°C. These dried samples were cooled in a desiccators for about 10 minutes. 50 mg powder of each fruit sample was taken in a centrifuge tube. To each tube 5 ml of 1.5N sulphuric acid was added. Digestion of the powder was completed by keeping the tube in a water bath for two hours at 90-95°C. The digested sample was centrifuged at 4000 rpm and supernatant was collected in a 25 ml volumetric flask with two washings and the final volume was made up to the mark with distilled water. 1 ml of this extract was diluted to a required level. 1ml of this diluted sample, 1ml of water and 1ml of phenol (5.1%) was poured in each test tube and placed in beaker containing chilled water and 5 ml of concentrated sulphuric acid was pipetted quickly into each test tube. After half an hour the pale yellow coloured solution was transferred to a colorimetric tube and the transmittance was noted at 490 nm on a specific “VIS Spectrophotometer”. A blank was also run simultaneously. The reading of each sample was compared with a calibration curve, obtained by using known graded dilutions of standard glucose solution.

Nitrogen

Various fractions of nitrogen present in the plant tissue were estimated using the modified Micro-Kjeldahl technique [7].

Fifty milligrams of dried fruit sample was homogenised in 80% ethanol. The homogenate was centrifuged at 500 rpm for 10 min. The clear supernatant was used for estimation of alcohol soluble nitrogen and the residue for insoluble nitrogen. Each fraction was separately transferred to a 100 ml Kjeldahl flask and dried in an oven at 70°C. The dried matter was then digested. The digestion was done with 1.0 ml conc. H_2SO_4 (nitrogen free and containing 1.0 g of salicylic acid in 20 ml of the acid). The material was mixed thoroughly and was allowed to stand for at least 20 minutes. A little (approximately 0.03 g) of sodium thiosulphate was then added and the mixture was heated slowly until the fumes appeared at the mouth of the flask. It was then cooled and 1.0 ml of 60% perchloric acid was added. The acid, in 500 ml contained 0.25 g of copper sulphate. It was further heated on a hot plate until the solution became clear. The light blue digest was transferred to 50 ml volumetric flask. The Kjeldahl flask was washed several times with distilled water and the washings pooled with the digest. The volume was then made up to 50 ml. To 1 ml of the digest, 2.0 ml of distilled water and 2.0 ml of Nessler's reagent were added and the mixture was allowed to stand for 10 min. The colour intensity of the content was measured in a Spectrocolorimeter at 440 nm. The amount of nitrogen was calculated with the help of a standard source of nitrogen. The amount of nitrogen is expressed as mg/g dry weight of the tissue. The values of soluble and insoluble nitrogen so obtained were added to get the total nitrogen content.

Protein

The protein of fruit was estimated [8].

Sufficient amount of fruits powder was spread over a sheet of paper and dried overnight in an oven at 80°C. The dried samples were cooled in a desiccator for about 5 minutes before weighing. 50 mg of each sample was taken and transferred to a mortar. 1ml of cold 5 percent trichloroacetic acid was added in to it. The powder was grind well and the homogenate was collected in a centrifuge tube with 5 percent trichloroacetic acid. It was kept for one hour to allow the complete precipitation of proteins. The homogenate was then centrifuged at 4000 rpm for 15 minutes and the supernatant was discarded. To the residue 5 ml of 1N sodium hydroxide solution was added and shake well for complete mixing. It was kept for half an hour on a water bath at 60°C to dissolve the precipitated protein completely. After cooling for 15 minutes the mixture was centrifuged at 4000 rpm for 15 minutes and the supernatant together with three washings with 1N sodium hydroxide was collected in a 25 ml volumetric flask. The volume was made up to the mark with 1N sodium hydroxide and used for estimation of total protein in the fruit.

RESULTS AND DISCUSSIONS

In the present study, the data related to the chlorophyll (chl. a, chl. b and total) and nutrient contents (carbohydrate, nitrogen and protein) of tomato treated with different concentrations (0%, 25%, 50%, 75% and 100%) of textile industry effluents recorded on 30, 45 and 60 days after transplanting (DAT) have been presented in table 1 and fig. 1 to 3 respectively.

From this data, it is found that maximum amount was recorded in 0% concentration of effluent (control). As the concentration of effluent increased there is continuous decrease in chlorophyll and nutrient contents (carbohydrate, nitrogen and protein) of tomato. Minimum amount was recorded with 100% effluent concentration as compared to control.

Results of present study are supported by the study of influence of wastewater of fertilizer factory on chlorophyll of *Cicer arietinum* (gram) at various wastewater concentration [9] and observed that chlorophyll content reduced gently with increase in concentration of wastewater. Chlorophyll content enhanced at 25% concentration on 21days. [10] Decreasing protein content in rice seedlings with increasing industrial effluent concentration.

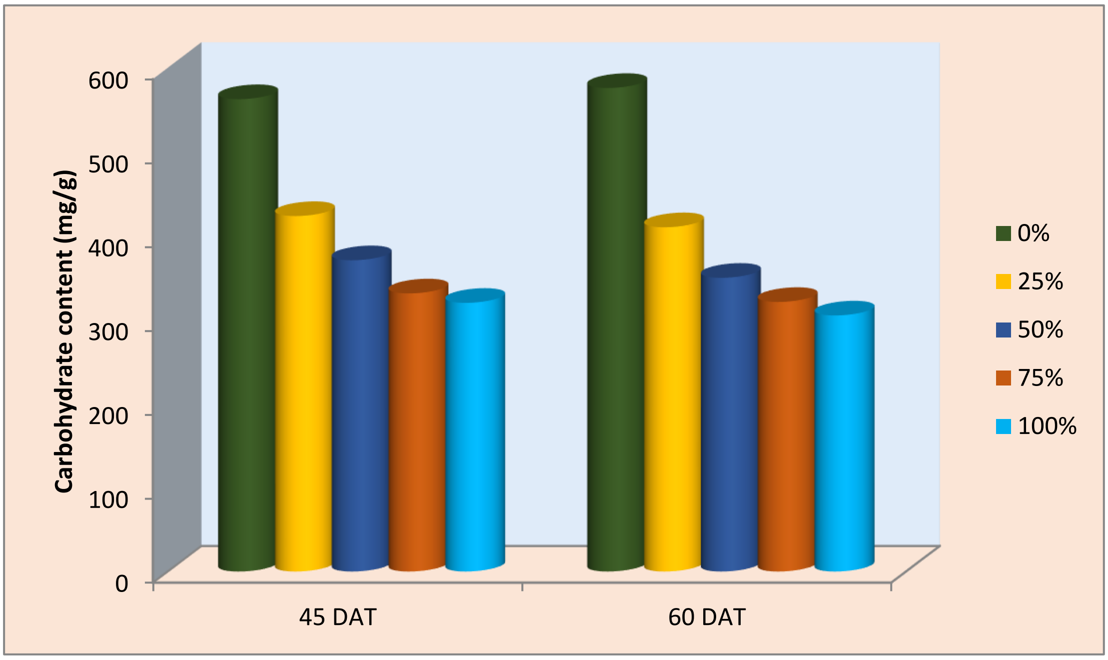
[11] The starch, total sugars and reducing sugars were reduced significantly (43%, 58% and 55.4%) in *Arachis hypogaea* when treated with viscose factory effluent. [12] Decrease in carbohydrates in groundnut and maize seedlings germinated with diluted photo film factory effluent.

Table 1: Effect of textile industry effluent on chlorophyll content (mg/g) in leaf of tomato

Effluent conc. (%)	30 DAT			45 DAT			60 DAT		
	Chl. a	Chl. b	Total	Chl. a	Chl. b	Total	Chl. a	Chl. b	Total
0	0.516	0.447	0.963	0.519	0.462	0.981	0.526	0.470	0.996
25	0.512	0.414	0.926	0.505	0.405	0.910	0.497	0.395	0.892
50	0.437	0.341	0.778	0.413	0.314	0.727	0.403	0.306	0.709
75	0.412	0.317	0.728	0.406	0.307	0.712	0.386	0.292	0.678
100	0.405	0.306	0.711	0.354	0.291	0.645	0.332	0.272	0.604
SEm±	**0.0051**	**0.0102**	**0.0096**	**0.0106**	**0.0083**	**0.0177**	**0.009**	**0.0093**	**0.0166**
CD (5%)	**0.0158**	**0.0315**	**0.0297**	**0.0326**	**0.0257**	**0.0545**	**0.0279**	**0.0288**	**0.0510**

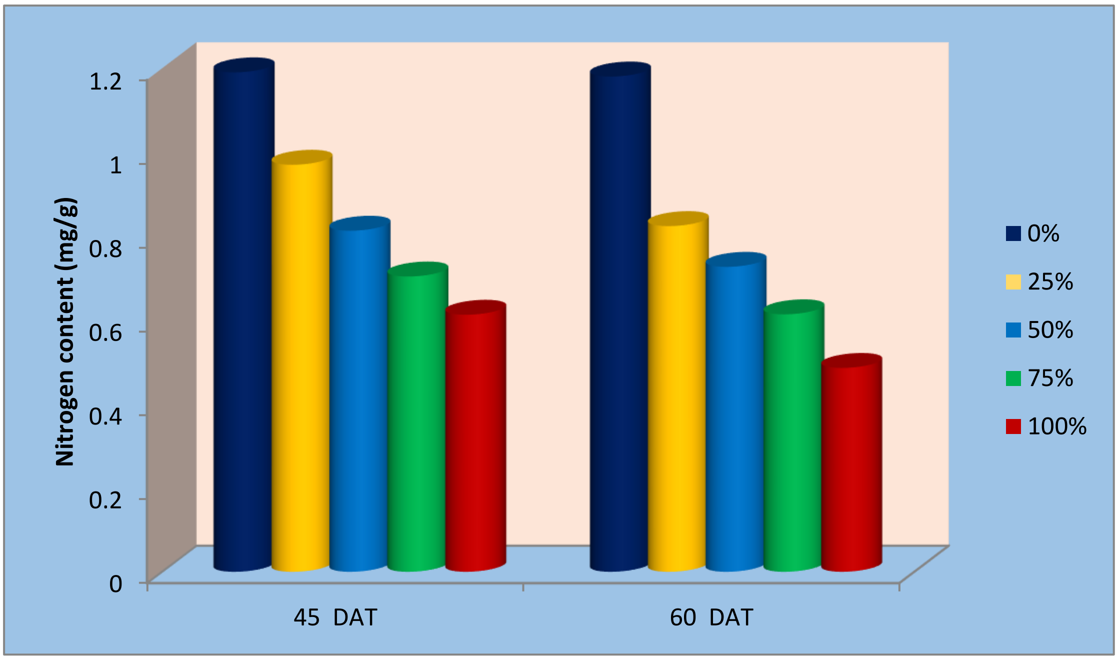
DAT = Days after transplanting

Figure 1: Effect of textile industry effluent on carbohydrate content (mg/g) of tomato fruit



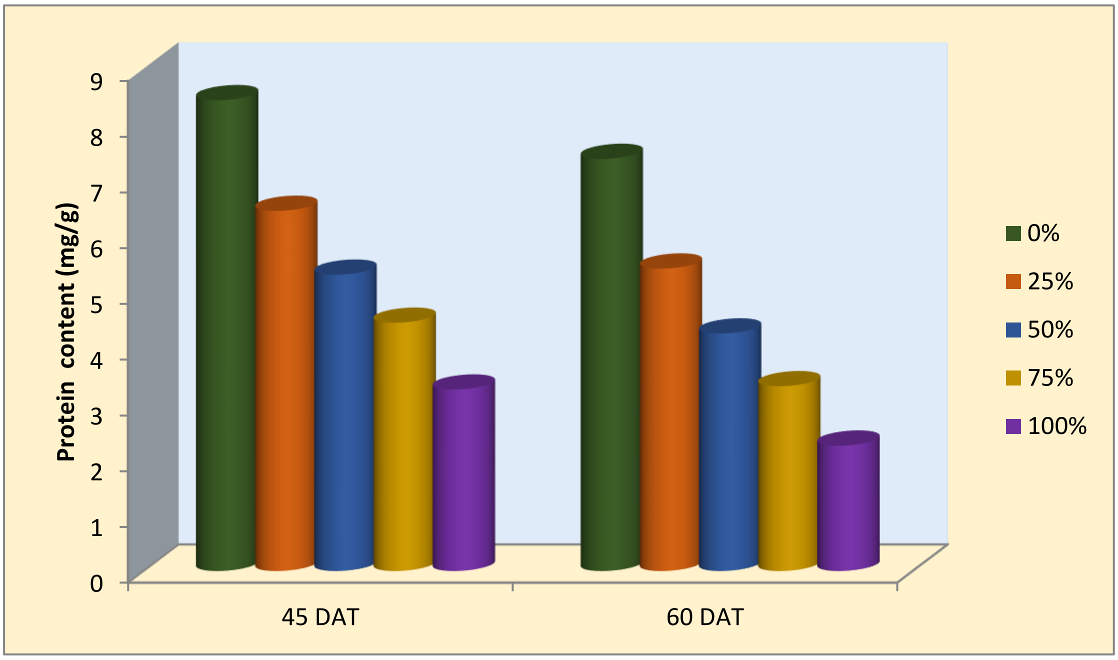
DAT = Days after transplanting

Figure 2: Effect of textile industry effluent on nitrogen content (mg/g) of tomato fruit



DAT = Days after transplanting

Figure 3: Effect of textile industry effluent on protein content (mg/g) of tomato fruit



DAT = Days after transplanting

CONCLUSION

This study concluded that effluent of textile industry affects the tomato plant. It is found that minimum amount was recorded in 0% concentration of effluent (control). As the concentration of effluent increased there is continuous decrease in chlorophyll and nutrient content. Maximum amount was recorded with 100% effluent concentration as compared to control.

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