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ORIGINAL RESEARCH

Cytogenetic Study of *Allium cepa* Root Tip Cells treated with Textile Effluent

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ABSTRACT
The aim of the present study is to focus on the chromosomal aberrations observed in *Allium cepa* root tip cells treated with textile effluent. In this study different concentrations of textile effluent (0%, 20%, 40%, 60%, 80% and 100%) were taken in couplin jar and onion bulbs were placed on top of it. The observation showed that textile effluent induced mitotic cell division showed chromosomal abnormalities like sticky chromosomes at metaphase, tail projection, laggard chromosomes, bridge at metaphase, binucleolar cells and disturbed chromosomes at metaphase. Sticky chromosomes were most commonly found in all concentrations of textile effluent. Mitotic index decreased with increase in concentration of the effluent.

KEY WORDS: *Textile effluent, Allium cepa, chromosomal aberrations.*

Introduction

The uncontrolled presence of various chemicals in the ecosystem, diversification of synthetic drugs and the use of pesticides in agricultural crops have become inescapable necessity. Industrial effluents are undesired by-products of economic development and technological advancement. When such wastes are improperly discharged off, they imperil human health and the surrounding environment. Surat is a place where more than 550 textile industries are located and they generate huge amount of wastewater in the form of effluent. Now-a-days effluent has used to support agricultural production and the area of land under irrigation with industrial effluent has increased significantly due to the scarcity of water supply. Effluent reuse can provide considerable social, economic and environmental benefits when used under controlled conditions to protection of plant and human health D. K. Shrivastava *et al.* Genotoxic chemicals used for many purposes in manufacturing processes can be found in environmental compartments such as air water soil and sediments. The chemicals can enter the environment from discharged wastewater, air emissions, during consumption of the products and from domestic and industrial waste sites.

Generally toxic effects of environmental pollutants cause genetic damage on plant cells. But toxicity is not always correlated with genotoxicity, Kovalchuk O *et al*. A large number of compounds have been identified for clastogenic, mutagenic and carcinogenic abnormalities usually induce genetic damage as well, Sugimura T S Kondo *et al*. The wastewater from different industries is also known to induce chromosomal abnormalities in plant cells Ray, Malabika *et al*., Somashekar *et al*. and Thangapandian V. *Allium cepa* roots can easily grow in water using its bulb and so this was used for studying the cytogenetic effect of textile effluent.

The aim of the present study is to focus on the chromosomal aberrations in *Allium cepa* due to effluent of textile industry

and also to determine the relation between mitotic index and chromosome abnormalities. The chromosomal abnormalities and disturbed chromosomes are a proof that the DNA is being damaged due to the presence of various azo dyes and other chemicals in the effluent. The most important advantage of allium test is that it is a low budget assay which besides being fast and easy to handle also gives reliable results.

Materials and methods

Sample collection and treatment

Effluent sample was collected from textile mill Surat, Pandesara region in a clean 5litre plastic container. The sample was stored at 20°C. Temperature, pH and colour of the sample were immediately noted during the time of collection at site. Various physico-chemical parameters of the effluent were tested using standard methods from APHA.

Experiment outline

Effluent was taken in different concentrations in coupling jar (0%, 20%, 40%, 60%, 80% and 100%) and onion bulb of size 15 to 25mm in diameter were placed on top of it. Root development was seen in different concentrations at different rates. Root tips were collected from different concentrations and observed for chromosomal aberrations.

Slides were prepared by using Darlington's method.

Mitotic index was also calculated at different concentrations using the formula

MI = Number of dividing cells/Total number of cells counted ×100

Result and Discussion

The below table is of Mitotic index of control and subsequent concentrations such as 20%, 40%, 60%, 80% and 100% concentration.

Mitotic Index	In Percentage (%)
Control	**39.5%**
20% Effluent	**26.38%**
40% Effluent	**22.43%**
60% Effluent	**19.83%**
80% Effluent	**12.34%**
100% Effluent	**4.27%**

Table1: Characteristics of the water sample from Pandesara region polluted with treated effluent from a textile industry compared with CPCB standards

S/N	Parameters	Mean levels detected	CPCB standards
1.	Temperature	29°C	-
2.	Colour	Reddish Brown	-
3.	pH	6.7	6 to 8.5
4.	Total solids	3810 mg/l	2200 mg/l
5.	Total Suspended Solid	2240 mg/l	100mg/l
6.	Total Dissolved Solid	1570 mg/l	2100mg/l
7.	Aluminium	0.20 mg/l	-
8.	Cadmium	0.196 mg/l	0.005mg/l
9.	Chromium	0.181 mg/l	0.05mg/l
10.	Copper	0.113 mg/l	1mg/l
11.	Iron	37.266 mg/l	0.3mg/l
12.	Lead	2.13 mg/l	0.1mg/l
13.	Nickel	0.869 mg/l	0.1mg/l
14.	Zinc	0.248 mg/l	5.0mg/l

The result reveals that most of the aberrations observed in chromosomes at metaphase and anaphase, very few in prophase and telophase. The study showed that the mitotic index decreased with increase in effluent concentration.

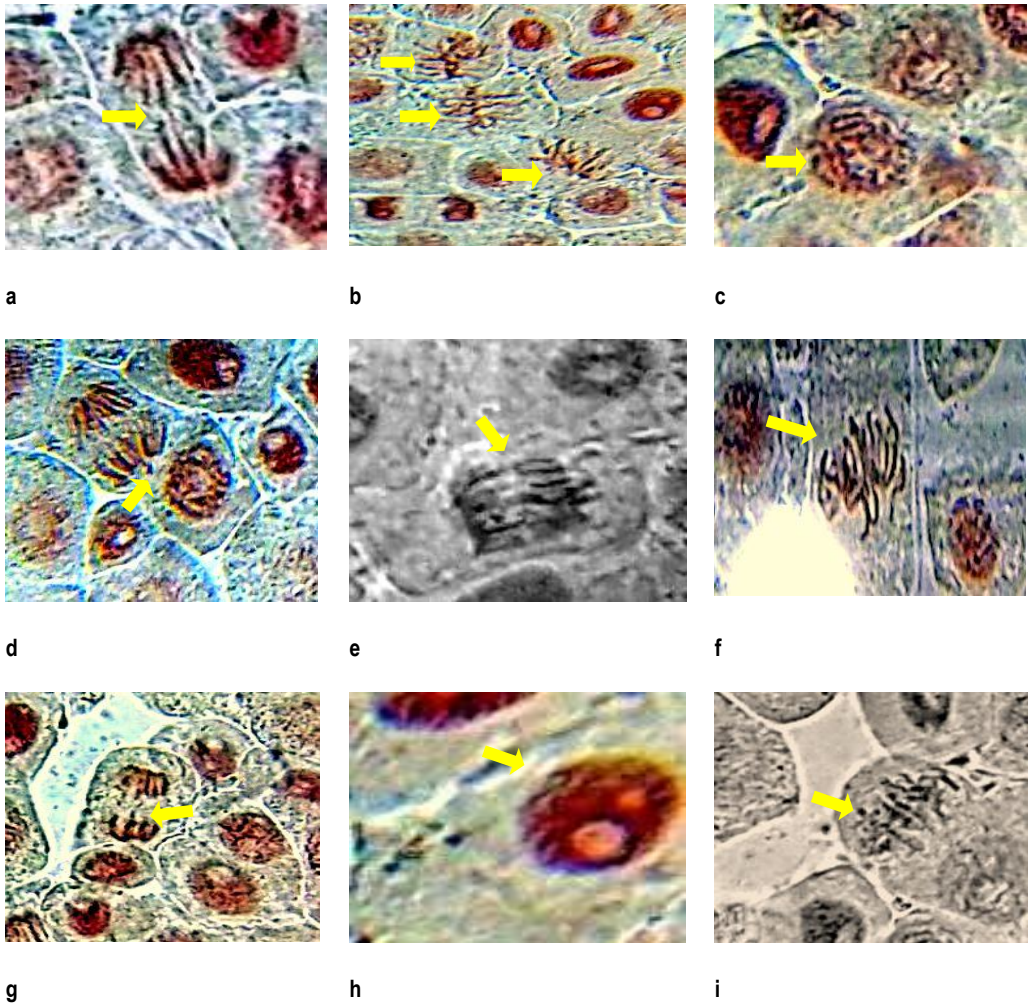

Figure.1: a and e- Bridge at metaphase, b and f- Sticky chromosome at metaphase, c- Normal prophase, d- Tail projection at metaphase, g- laggard chromosome, h- binucleolar cells, i- disturbed chromosomes at metaphase. The photographs were taken in Axioscope.A1 Zeiss at 100X.

Chromosomal aberrations are changes in chromosome structure resulting from a break or exchange of chromosomal material. Results showed among other aberrations, induction of sticky chromosomes, bridges and disturbance of chromosomes at different stages of mitotic division in the onion root cells. In *A. cepa*, whenever chromosome aberrations occurred, there were almost always certain growth restrictions (Fiskesjo, 1997). Most of these aberrations are lethal which can cause genetic effects, either somatic or inherited (Swierenga *et al*., 1991). The reduction in the mitotic index clearly indicates the mitodepressive and cytotoxic effects of the textile effluent on the present test system. This might have been achieved by the inhibition of DNA Sudhakar *et al,* 2001.

The sticky chromosomes have resulted in abnormal uncoiling of chromosomes during anaphase to telophase Qian X W *et al*. The sticky nature of chromosome may be due to delay in chromosome movement by pesticide treatment. Thus the chromosome could not reach the poles and remained scattered in the cytoplasm and appeared condensed and sticky Ajay K J *et al*.

The bridge formation can be due to the general stickiness of the chromosome at metaphase stage, or breakage and reunion of chromosomes. Similar type of abnormality was also observed in the mitosis of *Vicia faba* after treatment with

the organophosphorus insecticide Amar S. M.*et al* 1987. Lagging chromosomes arise mainly due to abnormal spindle formation and as a results spindle fibre failed to carry the respective chromosomes to the Polar Regions and resultantly lagging chromosomes appeared Tarar J L*et al* 1980.

Conclusion

From these observations it can be concluded that the indiscriminate use of dyes in textile industries and ultimately release of effluents which contain toxic compounds beyond the tolerance level can produce harmful effects on living systems including human beings. The large number of extensive and intense research proves the potential toxicity of textile effluent over soil and aquatic biodiversity, mainly a pre-treatment stage is very essential for wastewater remediation. The present research work emphasis a new integrated technology is required for assessing the complete wastewater treatment in order to be reused.

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