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EVALUATION OF CYTOTOXIC EFFECT OF SEWAGE WASTE ON ALLIUM CEPA

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Abstract

Treatment with 5%, 10% & 15% concentrations of sewage waste for 24 hours show decrease in mitotic index in onion. A significant decrease in MI was noted at 5% and 15% concentrations. The chromosomal aberrations (numerical & structural type) were observed. Decrease in MI was caused by the cell killing of the non resistant cells. The cell killing might be due to either damages of internal milieu of cells leading to mitotic poisoning or/and by the formation of reactive oxygen species and ions that increase the mutant bearing cells resulting to decrease in mitotic index with the retardation of the length of the roots. This might be effect the quantity of the yield.

Keywords: Sewage, Waste, Onion, Mitotic index, Chromosome.

INTRODUCTION

Pollution is the unfavorable alteration of our environment largely as a result of human activities. Water pollution is most common, which results from discharging of unprocessed waste into the land & water bodies. Industrialization movements in several cities have contributed to large amount of pollutants through indiscriminate discharge of effluents into drains with long term implication on ecosystem functioning [1]. In small towns and cities, domestic sewage waste water is one of the important causes of water pollution. Waste water contains about 220 mg/L of both suspended solids and BOD [2]. These constitute about 99.9% water & 0.02-0.04% solids of which protein& carbohydrates (40-50%), fats-5 % [3]. Sanitary sewage in form of waste from toilet, detergents [4], cattle faecal matter[5], medical disposed materials [6] contribute to increase water pollution. Sanitary wastes contain a wide range of genotoxic substances such as N-nitroso compounds, aromatic amines and Polyaromatic hydrocarbons. These wastes may also contain pathogenic bacteria and viruses that may induce various diseases in human.

Bhagalpur is an ancient silk city and has number of silk bleaching and dyeing factories which also discharges their untreated waste directly or indirectly into river Ganga through different outlets and cause water pollution. These small scale industries generally useazodyes which are mutagenic & carcinogenic [7]. Thus the collected water from the sewage contains not only the wastes of toilet, detergents etc. but also the effluents of silk dyeing and bleaching chemicals.

Sewage effluents contain many toxic elements (chromium, copper, iron, zinc, manganese, aluminiumetc) which induce teratogenic, clastogenic, mutagenic and carcinogenic effects [8]. There are also presence of certain cations and anions which might cause adverse effect on soil properties and plant growth. Genotoxicity of industrial wastes from Chemical [9], Steel [10], Paper [11, 12, 13], Fertilizer [14,15].Pharmaceuticals factories and effluents from other industries have already been evaluated [16]. Unfortunately, the genotoxic effect caused by sewage wastes is poorly known [17]. In the present investigation genotoxicity caused by sewage waste was evaluated in root tip cells of *Alliumcepa*.

MATERIALS AND METHODS

Sewage waste was collected from the main outlet of town near Lalbag colony. This waste was considered as 100% concentration. 5%, 10%, 15% concentrations were prepared after dilution with distilled water. 6 bulbs of onion (average wt. 40-45 g) were taken for each concentration.

After growing 1 to 2 cm long roots, they were treated with these concentrations for 24 hours. A concurrent control was also maintained where there is no treatment was done. After 24 hours of treatment, these roots were cut, wash, fixed and preserved in 70% alcohol. Acetocarmine stain - squash preparation were made. For each concentration, about 2000 cells were randomly analyzed. Frequency of mitotic index and phases thereafter were calculated. The chromosomal abnormalities, if any, were noted.

RESULTS AND DISCUSSION

Sewage waste has lead to significant decrease in mitotic index (MI) at 5% and 15% concentrations (Table-1). Upon 5% treatment, this decrease in MI is due to decrease in prophase cell population. Upon 15% concentration, this decrease is mostly due to decrease in all phases of cell division. Upon 10% treatment, no significant decrease in MI was observed (Fig.1 and Fig. 2).

As soon as the concentration increases, death of the cell population also increases. However, upon 10% treatment such result is not apparent. Such effect might be due to the death and compensation of the resistant cells [18]. Chromosomal abnormalities like hypoploidy, polyploidy, double metaphase and breaks were most common. The exact molecular mechanism for this damage cannot be pin pointed but it is possible that toxicants induced damages mostly either due to the death of the affected cells or in rare occasion, affected cells may survive and multiply successfully through succeeding mitotic or meiotic generations. The wastes might be producing changes at two different levels, first by affecting internal milieu of cell leading to the mitotic poisoning and/or by affecting the chromosome morphology as a consequence of production of reactive oxygen species (electrophilic ions). These electrophilic ions produced during the metabolism of waste might be interacting with the nucleophilic site of DNA leading to formation of the mutant bearing cells [19] with an elimination of affected cell population. The remaining non mutant/resistant cell population underwent the process of compensation by scavanging the ROS or electrophilic ions. Thus, sewage waste decrease mitotic index leading to the retardation of roots. So, the waste must be treated before using as irrigation purposes.

CONCLUSION

So from the above discussion we can conclude that sewage wastes is potential genotoxic agent and can damage the chromosome resulting in the structural abnormalities and thus proved to be the hazardous factor.

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CONFLICT OF INTEREST: Declare none

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Table 1: Cytotoxic effect of sewage waste on mitotic index & their phases in onion root tip cells.

Concentration	Total no. of cells observed	Total no. of dividing cells	MI %±SE	Phase distribution						Abnormalities, if any.	
				Prophase		Metaphase		Anaphase + Telophase			
		No.		No.	%±SE	No.	%±SE	No.	%±SE	No.	Type
Control	3150	199	6.31±0.43	97	3.08±0.30	33	1.04±0.18	69	2.19±0.26		
5%	2020	100	4.95±0.25*	44	2.17±0.21	21	1.03±0.02	35	1.73±0.15	10	Hypo, polyploidy, Metaphase break, Double metaphase, scattered prophase
10%	2283	154	6.74±0.13	78	3.41±0.12	27	1.18±0.07	49	2.14±0.04	5	Scattered, hypoploidy, metaphase
15%	2618	64	2.44±0.38*	24	0.91±0.28*	14	0.53±0.13	26	0.99±0.21*	12	Hypoploidy, breaks, chromosome thin, Diminishing, Polyploidy (Ana)

Here, * indicates the significant value at 5% level in comparison to the control value.

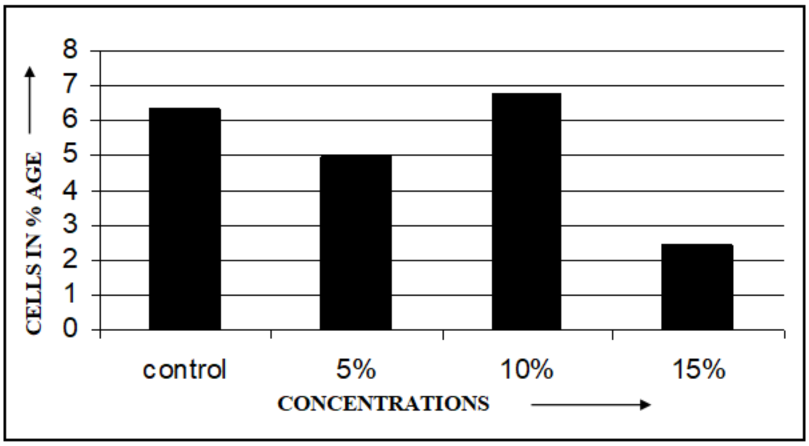

Fig 1: Graph showing % age of cells in division (MI).

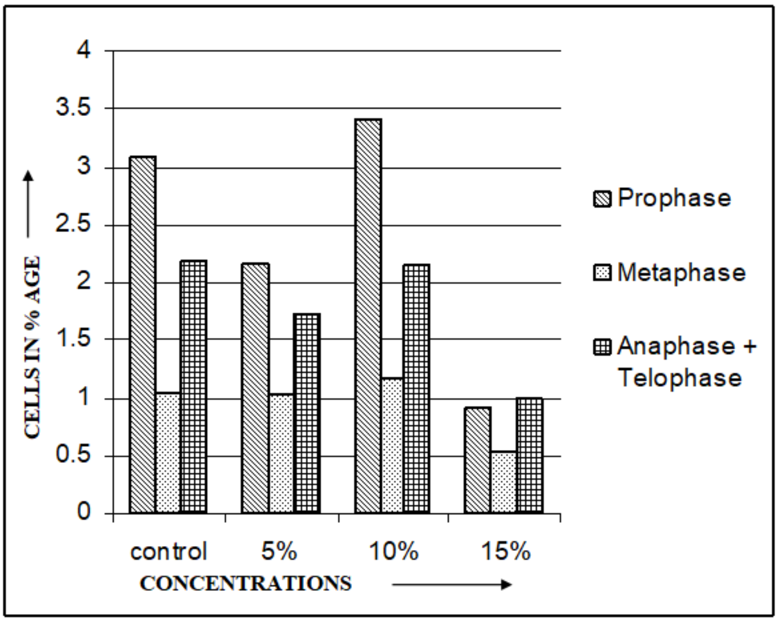

Fig 2: Graph showing % age of different stages of mitosis in onion root tip cells.

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