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Assessment of Genotoxicity of Polluted water of river Gomti using Allium cepa as test system

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ABSTRACT:-

Pollution of water resources is a serious and growing problem. The pollution of the aquatic environment by toxic chemical pollutants continues to occur with domestic and sewage effluents being the main sources responsible for the contamination of aquatic environment. The quality of water resources is correlated with human activities, since they use chemical to achieve social and economic goals and the lack of a correct environmental management there is discharge of human and domestic waste in these environment. The waters of four sites including Gomti that have been studied for their aquatic fungal flora contain substances toxic to the aquatic flora or fauna or both. To ascertain the above fact and experiment to assess genotoxic effects was undertaken using Allium cepa test system.

KEYWORDS:-

Water, Genotoxic, Lucknow.

INTRODUCTION:-

Of all the natural resources, water is one of the most important and highly exploited sources that are being polluted unabatedly. Water bodies, small or big, lotic or lentic, all are getting pollutants into them in varying quantities. This all is because of our rapid growth in population, industrial proliferation, urbanization and wide spheres of other human activities. Sewage becomes a nourishing medium of many forms of life viz, bacteria and fungi. These microorganisms transform several organic and inorganic waste into simpler but toxic compounds. Such compounds may or may not affect the life in water at a later stage or the end users of those waters. The waters of four sites including Gomti that have been studied for their aquatic fungal flora contains substances toxic to the aquatic flora or fauna or both.

The present paper deals with the genotoxic impact of polluted waters in Lucknow City, on Allium cepa root meristem. The research work aims to sample the condition of natural and man-made water bodies in the city of genotoxicity of waters.

MATERIALS AND METHODS :-

Water samples were collected from 4 different sites in the Lucknow City using standard (APHA et al 1976) collection method. Out of these three were from different locations of River Gomti and last from the pond located in J.N.P.G. College, in Charbagh region. The standard chemical and Physical analysis of the water was also done. (Table 1)

For cytological examination germinated onion bulbs with roots 1-2 cm. were placed in the 4 water samples for 12 hrs., 24 hrs., 48hrs. Necessary control set was also run along with the treatment. After each treatment, root tips were fixed in Farmer's fixative and analyzed by standard squash techniques:-

The mitotic index was calculated according to this formula:-

$$\text{Mitotic Index} = \frac{\text{No. of dividing cells}}{\text{Total no. of cells divided}} \times 100$$

The percentage of abnormal cell

$$= \frac{\text{No. of abnormal cells}}{\text{Total no. of cells divided}} \times 100$$

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Quantitative and qualitative observation was made by scoring a minimum of 5000 cells from different root tips in control and treated bulbs.

RESULT AND DISCUSSION :-

Mitosis was normal in case of controls. The water samples from all 4 sites caused various chromosomal abnormalities (Table 2). These included micronuclei, breakage, disintegration, bridges, fragments, binucleate conditions in majority of cases (Fig 1-9).

In all the 4 cases it was interesting to note that there is no significant presense of heavy metals. The chemical and physical analysis of water revealed that even the calcium and potassium contents were well below the pollution levels in all the 4 cases. Thus it can be hypothised that the abnormalities were basically caused by organic pollutants. The presense of microorganisms make the water toxic by conversion of pollutants in soluble toxic forms.

The result are synonymous with earlier workers who tested the effects of various polluted waters on mitosis viz Thangapandian et al (1995), Ateeq et al (2002), Monarca et al (2005), Unyayar et al (2006), Leme et al (2008), Blagejevic et al (2009), Oriraku et al (2011), Ozakca and Silah (2012), Min et al (2013).

In any case the abnormalities encountered in the present study are rather too different to be generalized. We can conclude that polluted waters are capable of inducing a variety of somatic cells abnormalities and the percentage of anomaly depends on the physico chemical nature. But one thing which comes in light is that the simple common pollutants can behave as potential mutagens. We can not conclusively proved but definitely some involvement of microorganism in conversion of pollutants in even more toxic forms is there. Fortunately enough the waters of the city are still not much polluted by heavy metals. None the less, problem of organic pollution can be dangerous is continued unabled.

Table-1 Comparative Chemical and Physical Analysis of Waters of 4 Sites

	Site-1	***Site-2***	***Site-3***	***Site-4***
Temperature (^{0}C)	29 ^{0}C	29 ^{0}C	29 ^{0}C	29 ^{0}C
Hydrogen Ion Concentrations	8.1 ^{0}C	8.0 ^{0}C	8.0 ^{0}C	7.8 ^{0}C
Turbidity (JTU)	21.65 ^{0}C	31.45 ^{0}C	23.1 ^{0}C	16.15 ^{0}C
Conductivity µ Mhos/Cm.	0.6765 ^{0}C	0.9105 ^{0}C	0.639 ^{0}C	1.0535 ^{0}C
Total Hardness (Mg./L)	295	290	285	395
Calcium (Mg./L)	68.136	70.14	74.148	78.156
Magnesium (Mg./L)	30.4	27.96	24.32	48.64
Carbonate (Mg./L)	16.5	31.5	37.5	22.5
Bicarbonate (Mg./L)	259.25	236.37	239.425	370.57
Total Alkality (Mg./L)	348.5	347.5	347.5	477
Sodium (Mg./L)	3.5	4.2	4.8	9.9
Potassium (Mg./L)	15.9	16	20.85	21.5
Free Co_2 (Mg./L)	13.5	15.0	22.25	11.25
Cl^- Ions	_`	_	+	+
PO_4^- Ions	_	_	+	+
SO_4 Ions	_	_	+	_
(-) Absent (+) Present				

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Table-2 (Abnormalities caused by Polluted water of Site-1,2,3 & 4 in the root tip cells of Allium cepa.

Site	*Duration of Treatment*	*Total No. of cells studied*	*No. of dividing cell*	*Mitotic Index*	*Metaphase Abn. (%)*				*Anaphase Abn.*			*Telophase*		*Total Abnormal Cells*	*Total (%) Abnormal cell*
					Sc	*Cl.*	*Fr.*	*Pm.*	*Lg.*	*Br.*	*Cl*	*Lg.*	*Mn.*		
Site 1	12 hrs.	5428	244	4.49	4.09(10)	1.03(4)	0.81(2)	-	0.40(1)	0.12(3)	3.68(9)	0.81(2)	0.40(1)	32	13.11
	24 hrs.	5144	212	4.71	4.79(10)	1.88(4)	1.41(3)	0.94(2)	0.47(1)	1.41(3)	5.66(12)	0.97(2)	--	37	17.45
	48 hrs.	5132	209	4.07	8.61(18)	2.87(6)	1.91(4)	1.91(4)	1.43(3)	0.95(2)	7.17(15)	1.43(3)	0.47(1)	49	23.4
	Control	5000	615	12.3	-	-	-	-	-	-	-	-	-	-	-
Site 2	12 hrs.	6400	388	6.06	4.59(18)	1.53(6)	0.76(3)	0.25(1)	0.51(2)	1.02(4)	4.5(18)	-	0.5(2)	54	13.9
	24 hrs.	6424	379	5.8	4.48(17)	3.16(12)	1.03(4)	0.52(2)	0.26(1)	1.05(4)	3.16(12)	0.52(2)	0.79(3)	57	15.03
	48 hrs.	6342	348	5.48	3.44(12)	3.735(13)	0.862(3)	0.287(1)	0.574(2)	0.862(3)	6.60(23)	0.574(2)	0.287(1)	60	17.24
	Control	6500	858	13.2	-	-	-	-	-	-	-	-	-	-	-
Site 3	12 hrs.	5632	474	8.416	1.26(6)	0.632(3)	0.421(2)	0.210(1)	0.210(1)	1.05(5)	1.05(5)	0.210(1)	0.421(2)	26	5.48
	24 hrs.	5052	404	7.99	2.22(9)	0.24(10)	0.742(3)	0.24(1)	0.99(4)	1.23(5)	1.23(5)	0.24(1)	0.24(1)	39	9.65
	48 hrs.	5096	304	5.965	2.63(8)	3.94(12)	0.98(3)	0.65(2)	0.32(1)	0.98(3)	3.94(12)	0.65(2)	-	43	14.14
	Control	5000	700	14.00	-	-	-	-	-	-	-	-	-	-	-
Site 4	12 hrs.	5408	674	12.46	-	-	-	-	0.89	-	-	-	-	06	.89
	24 hrs.	5700	712	12.49	0.56(04)	-	-	-	0.421(03)	-	-	-	-	07	.98
	48 hrs.	5304	670	12.63	0.44(03)	-	-	-	0.44(03)	-	-	-	-	06	.89

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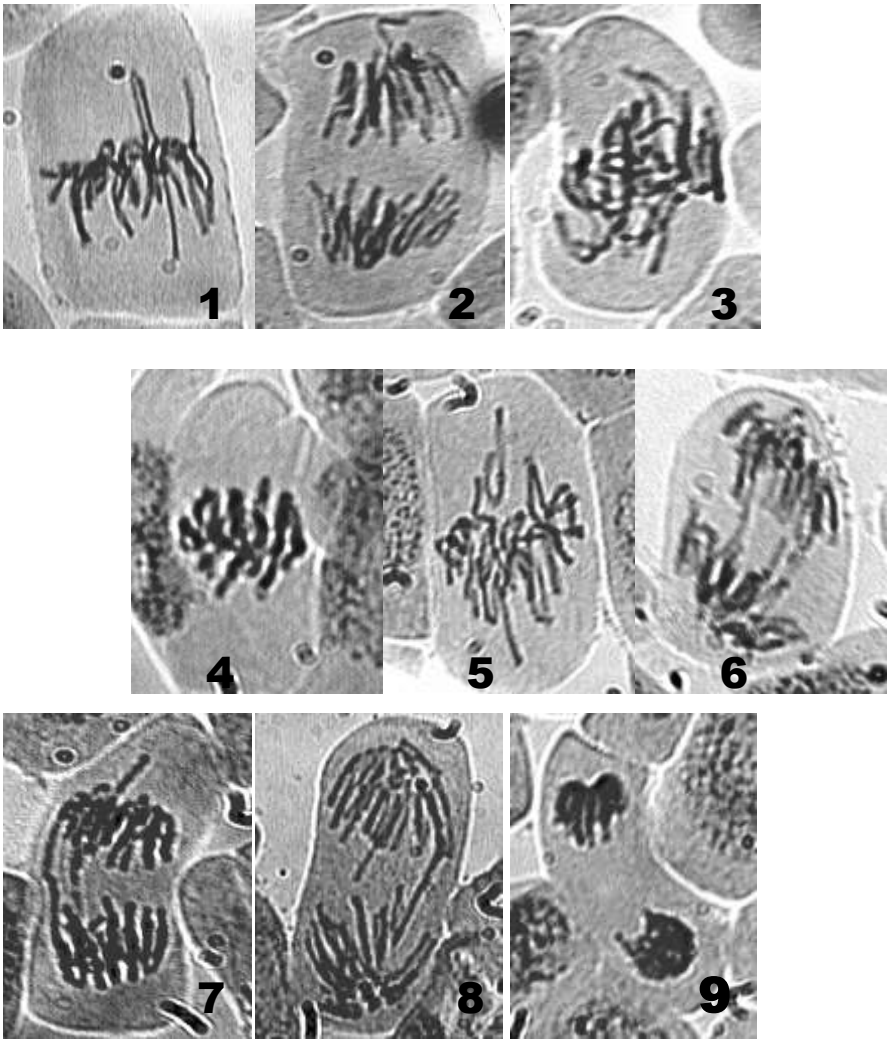

Explanation of figures

Fig. 1-2	:	Normal Mitosis in Allium cepa.
Fig. 1	:	Normal Metaphase.
Fig. 2	:	Normal Anaphase.
Fig. 3-9	:	Abnormalities induced in Mitotic Chromosomes of Allium cepa due to treatment with polluted water.
Fig. 3	:	Scattering at Metaphase.
Fig. 4	:	Stickiness/Clumping at Metaphase.
Fig. 5	:	Precocious movement at Metaphase.
Fig. 6,7,8	:	Bridges at Anaphase.
Fig. 9	:	Clumping at Anaphase.

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