

Cytological Irregularities Induced by Water Polluted with Factory Effluents : A preliminary report

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Man today is concerned very much with the pollution of his environment, the slow poisoning of his surroundings by his own activities. This is a major global health hazard. The genetical impact of such massive environmental pollution is not clearly understood. During the course of a study on the influence of polluted water on plants, a trial was carried out to assess the cytogenetic influence of water polluted by factory effluents.

Materials and methods

The present study was undertaken with *Ornithogalum virens* and *Allium cepa*. The polluted water was collected from a river in Calicut, into which the effluents from a nearby rayon factory is being discharged. The pollution of water in this river is quite massive, causing extensive damage to the aqueous flora and fauna. The river water collected from near the factory was used for irrigating the plants growing in pots. The application started before the commencement of flowering, and continued on alternate days. Three treatments-water collected as such, 1:1, and 1:2 dilutions with tap water were used. The flower buds were fixed in Carnoy's fluid and smear preparations were made in 1% acetocarmine. For mitotic analysis rooted onion bulbs were placed in the polluted water for a period of 24 hours and then fixed in acetic-alcohol and stained with basic fuchsin.

Results and discussion

The application of polluted water produced extensive rotting of roots. The meiosis in PMCs of *Ornithogalum* was very much affected by the treatment and as a result various chromosomal abnormalities were noted. Table 1 gives the frequency of various abnormalities observed. Chromosome breakage, absence of pairing leading to univalent formation, dicentrics, lagging, precocious and unequal separations, chromosome elimination etc, were noticed after the treatments. Sticki-

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ness was also very common. Some of the abnormalities are presented in Figs. 1-8.

It is evident from the data in Table 1, that the polluted water had deleterious effect on the meiotic system. The frequency of abnormalities increased from 10.2% in the control to 35.96% in the case of plants treated with undiluted polluted water. The pollen sterility as assessed by stainability in acetocarmine increased from 23.3% to 64.3% in this case.

Similar results were obtained in the *Allium cepa* test. Treatment of growing root tips for a period of 24 hrs was found to produce extensive chromosome ab-

Table 1. Frequencies of meiotic abnormalities in PMCs of *Ornithogalum virens*

Plant no.	No. of cells analysed	Breaks	Univalents	Multi-valents	Lagging	Ab-normal separation	Dicentric	Others*	Total (%)	Mean (%)
<i>Treatment No. 1</i>										
1	160	17	9	6	5	4	2	24	41.9	35.96
2	220	33	5	3	9	3	1	16	31.8	
3	190	21	4	1	7	4	2	24	33.1	
<i>Treatment No. 2</i>										
1	140	19	3	—	4	—	—	17	30.7	25.9
2	168	21	2	1	5	1	1	21	25.0	
3	145	14	2	—	4	—	—	12	22.1	
<i>Treatment No. 3</i>										
1	210	17	1	—	3	1	—	18	19.0	18.7
2	190	14	3	—	4	—	1	13	18.4	
3	160	12	1	—	2	1	1	13	18.8	
<i>Control</i>										
1	160	5	1	1	—	—	—	8	9.37	10.2
2	80	3	—	—	1	—	—	5	11.2	
3	180	7	—	—	2	—	—	9	10.0	

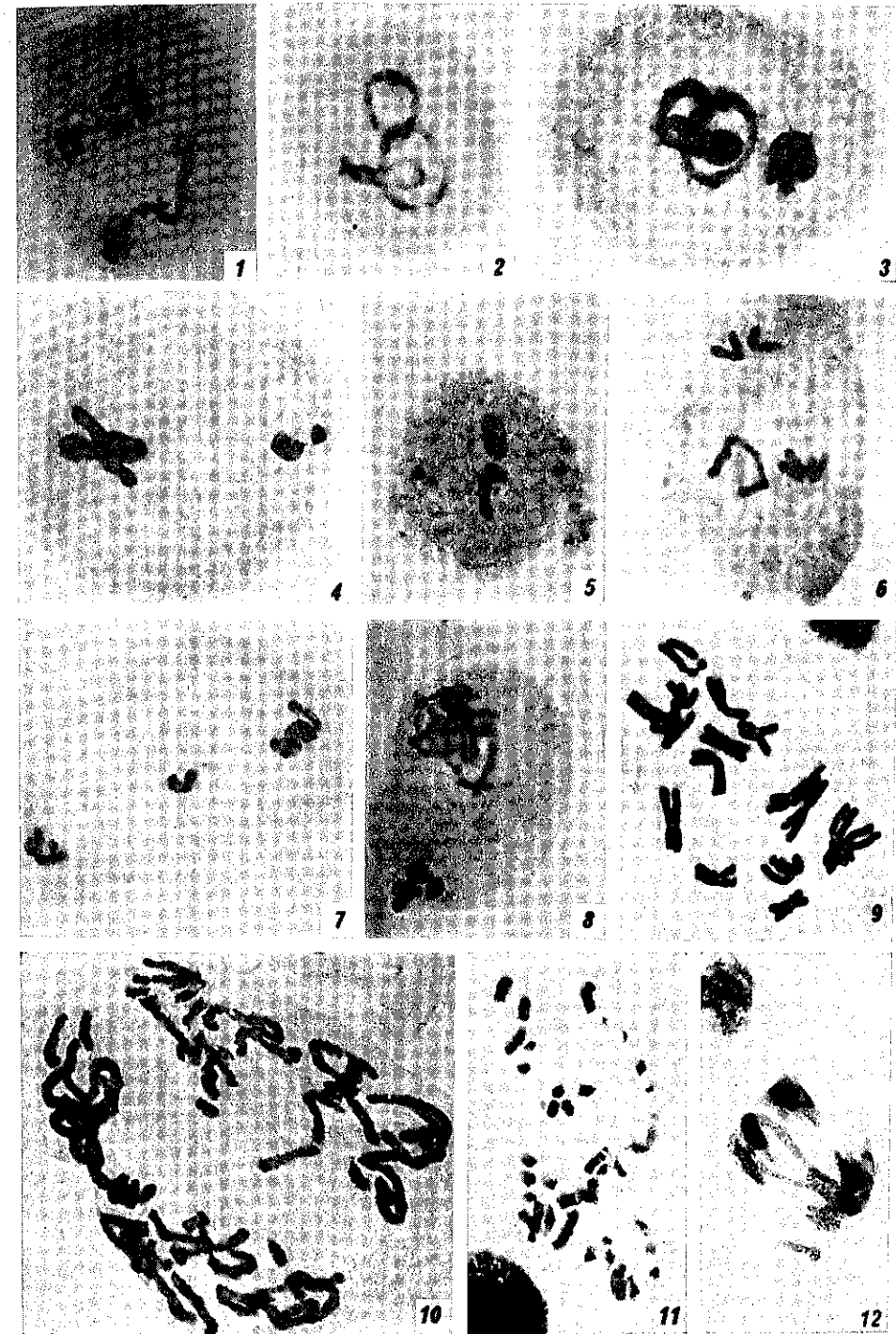
* Include clumping, micronuclei, multipolar spindle, unequal separation etc.

Table 2. Frequency of mitotic abnormalities in root tip cells of *Allium cepa*

Concentration	No. of cells analysed	C-mitosis	Stickiness	Breakages	Bridges	Abnormal separation	Others*	% abnormalities
1	220	2	24	42	7	4	13	41.8
2	190	1	18	33	2	1	11	34.7
3	235	4	14	28	1	1	9	24.2
Control	140	—	—	—	—	—	—	0

* Include abnormal condensation, multipolar spindle, chromatin erosion, binucleate cells etc.

normalities. The frequency was maximum in the case of undiluted water. This produced 41.8% abnormalities in mitosis (Table 2). The most common abnormalities were breakage and clumping of the chromosomes. Sometimes the clumping was so complete that the entire chromosome set appeared as stained mass. Breakage leading to one, two, or many fragments were observed in many cells. C-mitosis was noted in a few cases. Anaphase bridges, abnormal separations,



Figs. 1-12. 1-8. Meiotic abnormalities in *O. virens*. $\times 850$. 1-3, abnormalities in synapsis-univalents and interchanges. 4-5, metaphases showing fragments. 6-7, abnormal anaphases, showing unequal separations, dicentric chromosome, and laggard. 8, cell in second division showing chromosome extrusion. 9-12, mitotic abnormalities in *A. cepa*. $\times 1000$. 9, c-mitosis. 10, anaphase showing displaced spindle orientation and fragments. 11, severe chromosome breakages. 12, anaphase showing abnormal condensation, clumping, and bridges.

multipolar spindle, lagging, micronuclei, etc. were the other abnormalities noted. A few of these are given in Figs. 9-12.

The polluted river water has not been subjected to chemical analysis. Hence the ingredients that caused the abnormalities were not known. The water was acidic, the pH being 5.8. Prolonged treatment of roots with this water produced extensive rotting of roots, and thus was lethal to the cells. The study, though preliminary one, clearly pointed out the hazard of water pollution by factory wastes. This is especially important in the context of its use in irrigation. The pollution also destroys the balance of water ecosystem and thus has got considerable impact on the flora and fauna of the river. It is not known whether the harmful ingredients in the above case accumulate in the plant body, though this possibility cannot be ruled out. Under the existing condition such massive pollution will be a real threat to plant, animal, and human life.

Summary

River water polluted by factory effluents was tested for its cytological effects on plants. Growing plants of *Ornithogalum virens* were irrigated with such water and the treatment was found to produce many meiotic irregularities. The percentage of abnormalities increased from 10.2 in the control to 35.96 in the case of plants treated with undiluted polluted water, and the pollen sterility increased from 23.3% to 64.8%. Growing onion root tips when treated with polluted water produced extensive chromosome breakage, stickiness of chromosomes, and other mitotic abnormalities.

References

- Kihlman, B. A. 1966. Action of Chemicals on Dividing Cells. Prentice Hall. Englewood Cliffs, N.J.
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