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Cytogenetic Effects of Wastes of Copper Mine on Root Tip Cells of *Allium cepa* L.

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Abstract: The cytogenetic effects of the wastes of copper mine were investigated using root tip cells of *Allium cepa* L. The roots were treated with 10, 75 and 100 percent of copper wastes at 36 hour. Copper wastes caused some chromosomal abnormalities in root tip cells. It was found that copper wastes have a marked mitodepressive action on mitosis.

Key words: Cytogenetic effects, *Allium cepa*, copper wastes

Introduction

Many cytological studies have been carried out to detect the harmful effects of agricultural chemicals on various plants (Grover and Tyagi, 1980; Njagi and Gopalan, 1981; Mousa, 1982; El-Khodary *et al*., 1989; Kara *et al*., 1994). The effects of different irradiations and chemicals on plants have also been investigated (Nilan *et al*., 1973; Sander and Muehlbauer, 1977; Reddy and Annadurai, 1992; Kaymak, 1994; Agar and Uysal, 1997). Furthermore, it is known that mutagens significantly affect the sex organs, the most sensitive elements of a living organism and may seriously alter their fertility (Kaymak, 1994). However, in developed industrial systems, industrial wastes affect the genetic systems by producing various types of chromosomal abnormalities. This study was aimed to detect the effect of copper wastes on cell division and somatic chromosomes of *Allium cepa*.

Material and Methods

Clean and healthy bulbs of *Allium cepa* L. (2n = 16) were chosen to examining copper wastes at concentrations as 10, 75 and 100 percent, respectively. The solutions were prepared in tap water. The bulbs were placed directly in the test liquids. Controls were placed in only tap water (Kaymak, 1996). The bulbs were allowed to produce roots in beakers at room temperature for 36 h. Actively growing root tips were used for microscopic observations. The root tips were cut off and fixed in ethanol-acetic acid (3:1) solution for at least 24 h at 4°C. The root tips were hydrolyzed in 1 N HCl at 60°C for 12-13 min and then rinsed with tap water for 2-3 min (Inceer *et al*., 1999). Staining was carried out in Feulgen for 1.5 h. Ten to fifteen root meristems obtained from three to four bulbs per treatment were analysed.

Results and Discussion

The effect of the different treatment with copper wastes on the mitotic division in the root tip cells of *A. cepa* are given in Table 1. As could be seen from Table 1, the mitotic index (MI) decrease with increasing concentration. Similar results were obtained after treating *A. cepa* root cells with insecticides, herbicides, pesticides and chemical mutagens (Rao *et al*., 1987; El-Khodary *et al*., 1989; Jain and Sarbhoy, 1987; Shanker *et al*., 1987). A drop of mitotic index indicates that copper wastes interferes in the normal sequences of mitosis. Such reduction in the mitotic

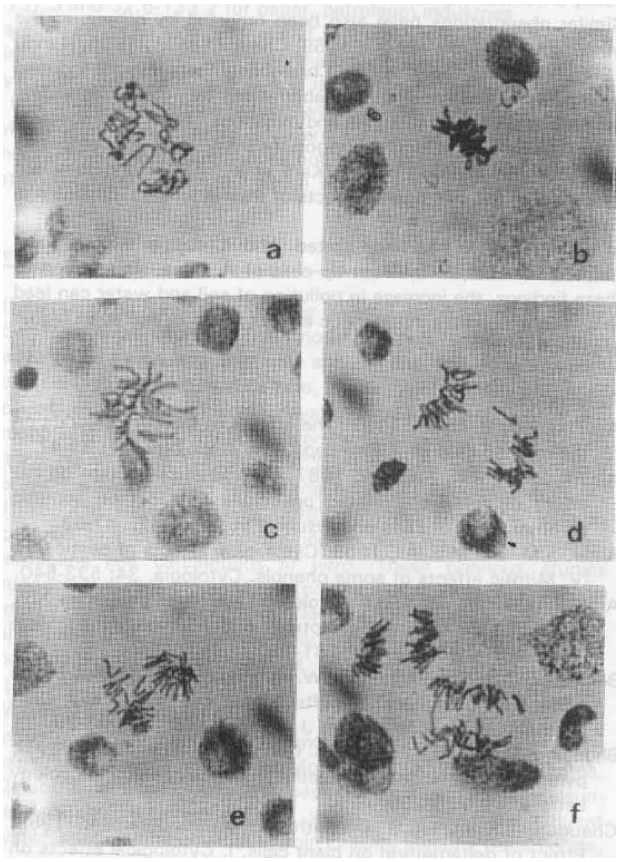

Fig. 1: Aberrations induced by copper wastes in root tip cells of *Allium cepa*, a) abnormal prophase, b) sticky chromosome, c) scattered chromosome, d) lagging chromosome, e) disturbed anaphase and f) chromatin bridge

Table 1: Effects of copper wastes on mitotic cell division of *Allium cepa* L.

Concentration	Total cells examined	Total mitosis	Prophase (%)	Metaphase (%)	Ana-telophase (%)	Mitotic index (MI)
Control	2600	164	56.70	20.73	22.57	6.30 ± 0.58*
10	2500	131	54.96	21.37	23.67	5.24 ± 1.53
75	2550	92	58.70	21.74	19.56	3.60 ± 1.15
100	2500	87	39.08	22.99	37.93	3.48 ± 1.00

*Standard deviation

Table 2: Somatic chromosomal abnormalities (%) in *Allium cepa* L. root tip cells induced by copper wastes

Concentration (%)	Lagging chromosome	Condensed and sticky chromosome	Scattered chromosome	Chromatin bridge
Control		0.6	1.2	
10	9.2	25.4	14	3.8
75	14.3	26.4	30	2.2
100	18.2	34.0	15	5.7

activity could be due to inhibition of DNA synthesis (Beu *et al*., 1978). This may suggest that copper wastes could have, the same effect.

The different kinds of chromosomal aberrations were presented in Table 2 and Fig. 1. The most common type of observed anomalies were chromatid breaks, lagging chromosome, condensed and sticky chromosome, scattered chromosome and chromatin bridge. Similar observations have also been reported by others, in the other systems (Amer and Ali, 1969, 1983; Chauhan *et al*., 1986, Nandi, 1985, Bhunya and Pati, 1988). Chromosomal aberrations induced by copper wastes are similar to aberrations by other insecticides, pesticides, chemical mutagens and radiations. Such chromosomal irregulations can affect the vigor, fertility, yield or competive ability of the exposed plants (Kara *et al*., 1994) and they are indicators of the clastogenic effects of their inducers (Tomkins and Grant, 1976).

In conclusion, as has been stated above, copper wastes have harmful effects on the root tip cells of *A. cepa.* In addition to these findings, the increase in pollution of soil and water can lead to certain irreversible cytogenetic effects in plants and even higher organisms.

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