Nature Environment and Pollution Technology © Technoscience Publications	Vol. 6	No. 2	pp. 311-313	2007

GENOTOXIC HAZARDS IN PLANTS INDUCED BY AGROCHEMICALS

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ABSTRACT

The paper deals with the genotoxic hazards of two chemicals *viz.* Turbutryn (herbicide) and Leptophos (insecticide) on the meristematic cells of *Vicia faba* L. The seeds of *Vicia faba* L. were treated with different concentrations of the two agrochemicals separately for 4 and 6 hrs at room temperature. It was noticed that both the chemicals induced chromosomal abnormalities, i.e., stickiness, fragment, bridge and c-mitosis. The abnormalities gradually increased with increasing dose of the pesticides. C-mitosis was caused due to treatment with 1% turbutryn for 6 hrs. It was interesting to note that Turbutryn is more genotoxic than Leptophos. Hence, before the use of agrochemicals, the genotoxicity level must be considered.

INTRODUCTION

Several million tons of organic and inorganic chemicals with antimicrobial and insecticidal properties are added annually to soil and environment. Some of them, killing the harmful organisms, not only upset the ecosystem but also produce undesirable changes in higher organisms. The mitodepressive and chromotoxic activities of herbicides in crop plants are well reported (Badar 1983). The induction of chromosomal anomalies by herbicides has been found to be associated with an action of these chemicals on DNA and RNA (Mohandas & Grant 1972, Chand & Roy 1981). Leptophos (4-bromo, 2, 5-dichlorophenyl thiophosphonate) is used for control of pests on cabbage (Workman & Greene 1970) and rice (Row et al. 1976). The *Vicia faba* L. root tip assay for the detection of chromosome aberrations from environmental chemicals is a well recognized system (Ma 1982).

The present study was undertaken in order to assess the genotoxic hazards from Turbutryn and Leptophos on meristematic cells of *Vicia faba* L.

MATERIALS AND METHODS

Seeds of *Vicia faba* L. (Fabaceae), treated with different concentrations of Turbutryn and Leptophos (0.25%, 0.50% and 1.00%) for 4 and 6 hrs, were washed thoroughly in the running water and put in petridishes for germination. Secondary root tips were fixed in freshly prepared 1:3 acetobutanol for 24 hrs and squashed in 2% acetocarmine to study the frequency of cell division and chromosomal abnormalities in different treatments.

RESULTS AND DISCUSSION

In *Vicia faba* L. the somatic number of chromosomes was noted to be 12. The chromosomal abnormalities were almost negligible in control, but the treated root tips showed considerable amount of abnormalities (fragments, laggards, stickiness and c-mitosis). The maximum abnormalities were observed in 1.00% concentration of Turbutryn (14.30%) and Leptophos (10.00%). It was interesting to note that only Turbutryn induced c-mitosis in 1.00% concentration. Leptophos showed very poor potential for the induction of bridge formation. A linear correlation between the concentration and amount of abnormalities was recorded in the treated root tips (Table 1).

Table 1: Chromosomal abnormalities induced by Turbutryn and Leptophos.

Treatment	Number of Dividing cell	Number of abnormal cell	% of abnormal cell	Fragments %	Stickiness %	Laggards %	Bridge %	C-mitosis %
Control	557	2	0.36	0.17	-	0.17	-	-
Turbutryn								
0.25% 4 hrs	240	17	7.10	1.20	1.50	1.60	2.80	-
6 hrs	210	23	9.00	2.00	1.00	2.20	3.80	-
0.50% 4 hrs	220	21	9.30	1.00	1.90	2.80	3.60	-
6 hrs	215	22	10.20	1.50	1.60	2.30	4.80	-
1.00% 4 hrs	235	31	13.10	1.20	2.22	3.90	5.80	-
6 hrs	235	33	14.30	1.20	3.22	2.90	7.00	0.45
Leptophos								
0.25% 4hrs	210	8	3.55	1.50	1.75	0.30	-	-
6 hrs	240	10	4.50	1.60	1.00	1.40	0.50	-
0.50% 4 hrs	230	11	4.80	2.10	1.20	1.50	-	-
6 hrs	210	14	6.60	2.80	1.20	2.60	-	-
1.00% 4 hrs	215	16	7.40	3.20	1.60	2.60	-	-
6 hrs	230	23	10.00	3.60	1.30	3.80	1.30	-

The use of pesticides has become a common practice in recent years in order to increase the productivity of various economically important plants. Their genotoxic effects have earlier been reported in *Allium cepa* (Badar 1983, Ahmad & Yasmin 1992) and *Vicia faba* (Sinha et al. 2006).

Chromosomal abnormalities may be result of a direct attack of agrochemicals on chromosomal material, probably DNA. However, it has been proposed that the action of the enzymes released from lysosomes could also break DNA (Allison & Paton 1965). It may be pointed out that prolonged application of agrochemicals inhibits the rate of mitosis and enhance the chromosomal abnormalities leading to deviation of the metabolic activities from its original parental line.

Increased concentration of agrochemicals interfere with the normal sequence of cell cycle that reduce the number of cells to enter prophase and succeeding divisional stages. Such type of mitodepressive action of chemicals have been reported earlier (deCampos & Viccini 2003). The fragments do arise due to either chromosome stickiness and translocation or DNA breakage by endonuclease (Grant 1978). The laggards may be formed due to failure of spindle mechanism. Spindle inhibition may be due to physiological effects exerted by agrochemicals. However, Grant (1982) reported spindle inhibition due to pesticides. Stickiness could be due to disturbances in the cytochemically balanced reactions or due to partial dissociation of the nucleoproteins and alteration in their pattern of organization (Evans 1962). C-mitosis is due to inhibition of spindle fibers and cell plate formation while stickiness is considered to be a physiological effect exerted by pesticides (Sinha et al. 2006).

Thus, it is clear that agrochemicals cause hazardous effect on chromosomal activities and balance of Turbutryn exerted higher genotoxic effects than Leptophos. Hence, it is suggestive that the use of agrochemicals needs consideration for their genotoxicity to plants.

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