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EFFECT OF SUMITHION ON THE GERMINATION, GROWTH, CHROMOSOMAL ABERRATION AND THE ENZYME AMYLASE OF *DOLICHOS BIFLORUS* L.[1]

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ABSTRACT

Sumithion, a contact insecticide was used in 300, 500 and 1000 ppm aqueous solutions for the treatments of dry seed of *Dolichos biflorus* to study its effect of some physic-morphologic traits and mitosis. This insecticide gradual reduction in germination percentwas noticed with increasing concentrations and durations of treatments. The lengths of epicotyl and hypocotyl decreased gradually in all the concentrations, but the primary root length showed an increase in all treatments except in higher concentration (1000 ppm) treated for longer duration (24 hrs.).

This insecticide has also induced various types of chromosomal aberrations and the increasing concentration and duration of treatments, showed increasing chromosomal abnormalities and the progressive reduction in mitotic indices (MI). It was noticed that, the enzyme activity was less in all the treatments of three durations when compared with the control sample— and the decrease in enzyme activity was accompained with reduction in length of seedlings.

INTRODUCTION

Chemicals used for the protection of crops against pests have multiplied in the past two decades. The agro-chemicals with mutagenic action might pose environmental hazards and there is a possibility that the wide scale use of pesticides may have adverse effects on human beings. Mutagenecity and biological action of a large number of pesticides has been recommended as one of the suitable methods (Epstein and Legator, 1971) to see their effects on plants. The present investigation deals with the mutagenic effect of a common insecticide, sumithion (O, O-Dimethyl-O-(3- methyl-4-nitrophenyl)-phosphorthioate), on germination, physiomorphological aspects and cytology of the pulse crop. *Dolichos biflorus* L. Cv. HG-93.

MATERIAL AND METHODS

The certified seeds of *Dolichos biflorus* CV-HG-93, taken as experimental material. One hundred seeds of *Dolichos biflorus* were soaked in 100 ml aqueous solutions of sumithion of 300, 500 and 1000 ppm concentrations. The treatments were given for 8, 16 and 24 hr. Simultaneously, a set of control was also maintained. Every time three replicates, each containing 100 seeds were taken. After thorough washing, the seeds were

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placed for germination at room temperature. Root tips were fixed in Carnoy's and slides were prepared by squash method. After 10 days the seedling growth, length of epicotyl, hypocotyl, primary root length and number of laterals were recorded along with the fresh weight of seedlings. The dry matter of the whole seedling was determined by keeping the plant material in oven at 80°C for 48 hrs. The activity of enzyme amylase was estimated after 48 hr. of seedling growth. For the estimation of amylase activity the method of Chinoy *et al.* (1969) was adopted and the activity was calculated as starch hydrolysed per hour gram fresh weight.

RESULTS AND DISCUSSION

During the present investigation, it was observed that sumithion has not significantly affected the germination of *Dolichos biflorus* seeds. The percentage of germination gradually decreased with increasing concentrations and durations of treatment (Table I).

TABLE I

EFFECT OF SUMITHION ON SEED GERMINATION AND AMYLASE ACTIVITY IN *DOLICHOS BIFLORUS*

Duration of treatment	Concentration in ppm	Percentage germination	Amylase activity*
Control	—	81.94±0.47	39.2
8 hr.	300	80.22±0.87	36.6
	500	79.33±0.38	36.0
	1000	76.55±0.64	33.4
16 hr.	300	76.40±0.58	30.1
	500	75.38±0.29	28.7
	1000	75.00±0.36	27.2
24 hr.	300	74.37±0.70	27.0
	500	73.67±0.49	25.8
	1000	64.60±0.27	23.4

*Amylase activity is expressed in terms of mg starch hydrolysed/hr/gm weight of the tissue.

It appears from Table II that, the effect of Sumithion on the lengths of epicotyl and hypocotyl decreased gradually in all the concentrations. Primary root lengths showed an increase in all the treatments except in 1000 ppm concentration, treated for 24 hr. duration. The effect was more pronounced on epi- and hypocotyl in 1000 ppm treated for 24 hr. Similar, reduction tendency in percent germination and seedling growth with increasing concentrations and duration of treatments was also reported by Krishnamurthy and Rao (1980) in *Brassica nigra* treated with two fungicides (antracol and Kitazin). The growth of the lateral roots was more in all the concetrations of sumithion treated for 8 hr. and also in 300 ppm for 16 hr. Again, in the higher concentration with longer durations, the decreasing tendency in the number of lateral roots was noted. The increase and decrease in the fresh and dry weights of whole seedlings was directly proportional to the growth of the seedlings (Table II).

Sumithion has induced various types of mitotic abnormalities such as broken metaphase, stickiness and clumping of chromosomes at metaphase, bridges and fragments and laggards and tetra-nucleate formation. The other notable effect of this chemical was disruption of the usual orientation of metaphase. There was progressive reduction in the mitotic indices (MI) with increased concentration and duration of treatments. It has also been noted that the percentage of abnormally dividing cells increased with the increasing concentration and duration of treat-

TABLE II

EFFECT OF SUMITHION ON SEEEDLING GROWTH AND FRESH AND DRY WEIGHT OF *D. BIFLORUS*

Duration in hrs	Concentration in ppm	Seedling length (cm)			Number of lateral roots	Total weight of ten whole seedling (in grams)	
		Epicotyl	Hypocotyl	Root		Fresh	Dry
Control	—	4.31±0.30	7.18±0.66	6.76±0.96	12.11±0.08	1.710	0.179
8	300	2.98±0.83	**5.46±0.69	**8.67±0.20	*16.65±0.94	1.690	0.145
	500	2.20±0.75	5.38±0.67	**8.05±0.84	*15.10±0.63	1.617	0.139
	1000	**2.00±0.91	5.25±0.36	7.90±0.49	**14.84±0.96	1.290	0.124
16	300	*1.90±0.64	5.23±0.60	**8.65±0.84	**13.65±0.90	1.290	0.120
	500	*1.75±0.82	*5.00±0.62	**8.57±0.44	**11.05±0.21	1.340	0.119
	1000	*1.21±0.42	*4.37±0.35	**7.78±0.87	**10.85±0.98	1.320	0.115
24	300	*1.20±0.51	*4.59±0.56	**7.54±0.62	**9.81±0.62	1.210	0.110
	500	*1.16±0.87	*4.21±0.70	**7.26±0.54	**9.45±0.66	1.280	0.101
	1000	*1.10±0.76	*3.15±0.89	**5.28±0.46	*8.74±0.58	1.265	0.096

*Significant at 1% level
**Significant at 5% level

TABLE III

FREQUENCY AND DISTRIBUTION OF CHROMOSOMAL ABERRATIONS INDUCED BY SUMITHION IN *D. BIFLORUS* ROOT TIPS

Duration in hrs.	Concentration in ppm	Total No. of cells observed	Mitotic Index	Type of aberration				Total No. of abnormal cells	Percentage of abnormal cells	Percentage for each time period
				Metaphase fragments	Anatelophase fragments	Bridges	Others			
Control	—	5896	6.87	—	—	—	—	—	—	
8	300	5138	6.62	4	9	5	7	25	0.46	0.61
	500	5217	6.10	6	10	6	9	31	0.59	
	1000	4934	5.94	8	12	6	13	39	0.79	
16	300	4816	5.85	5	11	7	9	32	0.66	0.81
	500	5106	5.41	7	13	9	10	39	0.76	
	1000	4763	5.13	10	15	8	15	48	1.01	
24	300	4868	5.06	7	10	9	12	38	0.78	1.04
	500	5016	4.82	9	14	10	13	46	0.92	
	1000	5127	4.46	19	26	12	16	73	1.42	

+Includes lagging chromosomes, stickiness, clumping and irregular metaphases.

ments (Table III). This has clearly indicated that there is a positive correlation between the retardation of growth and mitotic indices and induction of chromosomal aberrations. Similarly, Mohandas and Grant (1972) reported mitotic abnormalities in twelve species of weeds and cultivated plants induced by 2, 4-D and Amitrole which included chromosome bridges, fragments, lagging chromosomes and chromation bodies. Wuu and Grant (1966) studied the effect of Hyvar X, herbicide, on barley (*Hordeum vulgare*) and Bakale and Kolhe (1980) carried out cytological studies in *Tephrosia purpurea* treated with three herbicides namely 2,4 dichlorophenoxyacetic acid, Hyvar X and Gramoxone. For germination gramoxone was the most effective, and Hyvar X was the least effective. But for inducing chromosomal aberrations Hyvar X was the most efficient while Gramoxone was the least efficient. The response of 2,4-D was intermediate to both germination and induction of mitotic aberrations. Likewise, in the present investigation, sumithion induced various chromosomal abnormalities such as broken metaphase, fragments, bridges, laggards, sticky and clumping of chromosomes and multinucleated cells.

The activity of the enzyme amylase was less in all the treatments of three durations (8, 16 & 24 hr) when compared with the control sample, where the amount of starch hydrolysed was 39.2 mg/hr/gm tissue. The maximum retardation of activity was noted in all the concentrations of 24 hr. duration, the amount of starch hydrolysed in these treatments

(Table I). Amylase activity has been found to be positively correlated with seedling growth in all the treatments of this chemical. Thus, the insecticide brings physiological and various structural disturbances which ultimately lead to slowing down of plant growth.

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