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Research Article

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Physiological and Clastogenic Effects of SDS in Certain Allium Species of Nagaland

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ABSTRACT

The tremendous use of the chemical in daily life activity, animal and plant system prompted us to determine the physiological as well as clastogenic effects of this chemical in plant genetic system. The different Allium species (A. hookeri, A.tuberosum, A.chinense, A.ascalonicum) and concentrations (500 ppm,1000 ppm and 3000 ppm) for 3 h was used in the present study to observe the said effects on the genetics of this species. SDS (sodium dodecyl sulphate) is generally used in cosmetics, shampoos, soaps, detergents, as a leather softening agent in industry, as flocculating and de-inking agent in paper industry and engine degreasers, importantly used in nasal and ocular drug delivery, in trans-epidermal, to boost intestinal absorption of drugs in animal models and in biochemical research in the laboratories. The Methodology includes the young buds of different Allium species collected from the field and maintained at a room temperature of 23 ± 2°C for control and treatment study Flower buds for meiotic study were fixed in carnoys solution (ethyl alcohol and glacial acetic acid 3:1) for 24 hrs and followed by 70% ethyl alcohol. The buds were treated at different concentration for 3 h. The maximum physiological and clastogenic aberrations observed was stickiness, laggards, abnormal metaphase, micronuclei and ring chromosomes in the studied Allium species. Although, the maximum abnormality observed as stickiness and laggards (physiological) and micronuclei (clastogenic aberration) in the Allium species indicates the toxicity of SDS on the genomes of the plants.

Keywords: Sodium dodecyl sulphate; Toxicity; *Allium* species

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INTRODUCTION

Many chemicals have been playing a vital role in recent times used in different categories such as pesticides, herbicides, and in food as preservatives. Such role has caused to study the genotoxicity and toxicological effects in plants as well as organism which forms a part of our very existence. Some commonly used chemicals and its effect had been investigated to its level of toxicity in different organisms. Ethyl methanesulfonate (EMS) a compound widely used as a mutagen, brain carcinogen and teratogen and as a research chemical. The genotoxic effects of EMS were investigated with growing chilli seedlings at different concentrations (mM). Frequency of chromosomal aberrations increased linearly with concentration ranging between 10 and 50 mM and decreased above 50 mM. This showed considerable difference between control and 50 mM EMS or in higher concentration,which suggests that EMS has genotoxic effect on chilli root tip cells. Therefore, high doses of EMS inhibit the growth of chilli morphologically and cytological parameters strictly with aberrations such as stickiness, precocious movements, chromosomal bridge, micronucleus and others [1].

Allium cepa test has been conducted for genotoxicity and cytotoxicity using monosodium glutamate (MSG) and the macroscopic (morphology) or microscopic (mitotic index and chromosomal aberrations) were observed such as inhibition of tips, range in colour from brownish to dark brown to black and other chromosomal abnormalities [2].

Organic insecticides kingbo and Azdar 10EC used as agricultural pesticides were investigated for cytotoxic and genotoxic effects using root tips of *Allium cepa* assay. Three different concentrations were used for different periods

of time. Single treatment of azdar 10EC decreased the mitotic index and its effect was non-significant compared to the control, while 2.5 $mL.L^{-1}$ treatments for 24 h increased the mitotic index and was statistically significant. The treatments caused diverse types of chromosome abnormalites such as stickiness, disturbance, c-metaphase, stare metaphase, chromosome bridges in anaphase and telophase, lagging chromosome and micronuclei appearing in interphase cells. The result indicated that both organic insecticides had cytotoxic and genotoxic activities on mitotic index and chromosomal aberration [3]. In *Allium cepa* and *Allium sativm*, the cytogenetic effects of Avenoxan an herbicide, active substance 2,4-D, were investigated. In their study the concentrations of avenoxan used significantly induced abnormalities such as c-mitosis, bridges, chromosome stickiness, multipolar cells, laggards, compared to control. Significant decreased in mitotic index was also observed which was dependent on the concentration and time of treatment [4]. Thiabendazole (TBZ) toxicity and genotoxicity in its commercial formulation Foldan was studied in *Allium cepa* meristematic cells at concentrations ranging between 10 and 250 µg / ml. Results showed that exposure to TBZ induces a significant increase in the frequency of anaphase and telophase chromosomal aberrations, micronuclei and binucleated cells at all the concentrations of TBZ. An increase was also observed in the rate of metaphase and anaphase frequency which was an indicator of alterations in chromatid segregation. The study indicate that exposure to TBZ induces toxicity and genotoxicity, and interfere with microtubule formation [5].

A comparative account of cytological and developmental effects of EMS (ethyl methane sulphonate) and SA (sodium azide) on meiotic parameters were investigated. These mutagens are being used to improve quality traits and yield producing resistance in susceptible crops against harmful pathogens. The study for generation M1 on *linum usitatissimum* l. (NDL- 2002 variety), showed the mutagens EMS and SA brought forth various chromosomal aberrations in meiosis. Different meiotic aberrations such as 3-nucleate conditions, laggard, bridges at anaphase I, unsynchronized movement at metaphase I were recorded. The meiotic abnormalities increased with increase in mutagens concentration [6]. Because of various response of stress by many chemicals, the present study has been conducted using sodium dodecyle sulphate (SDS) as its involvement in house hold articles as a common ingredient and an emerging threat to the environment [7]. SDS is generally used in cosmetics, as a leather softening agent in industry, as flocculating and de-inking agent in paper industry and engine degreasers, importantly used in nasal and ocular drug delivery, in trans-epidermal, to boost intestinal absorption of drugs and in biochemical research to lyse the DNA and proteins in smaller molecular weights and separated using the electrophoresis [8]. Some effects has been reported in human beings such as respiratory irritation, breathing problems and may cause damage to lungs [9]. Moderate inflammation and dermatitis [10]. Some effects has also been reported in animals [11] fishes [12] and plants [13-17]. The environmental toxicity profile is an important consideration when evaluating the risks and benefits of using SDS in cleaning product formulation as well as other products uses the SDS as it's an important ingredient.

EXPERIMENTAL SECTION

Materials and Methods

The Methodology includes the young buds of different *Allium* species collected from the field and maintained in pots at a room temperature of 23 ± 2°C for control and treatment study. The flower buds were fixed in carnoys solution (ethyl alcohol and glacial acetic acid 3:1) for 24 h, followed by 70% ethyl alcohol for meiotic study. The buds were treated at different concentration of SDS (500 ppm, 1000 ppm, 3000 ppm) for 3 h and data were recorded for physiological and clastogenic aberrations.

RESULTS AND DISCUSSION

The physiological and clastogenic aberrations induce by different concentrations of SDS in different species of *Allium* recorded and presented (Tables 1 and 2). The physiological aberrations observed in different *Allium* species at different concentration in the form of laggards, stickiness, strayed chromosomes, abnormal anaphase and abnormal metaphase. The stickiness physiological aberrations has shown increasing trend from lower concentration to higher concentration in *Allium hookeri* and *Allium ascalonicum* while *Allium tuberosum* and *Allium chinene* could not locate any increasing or decreasing trend of this abnormality. The abnormality might be the effect of the chemical or the protein of chromosomes which helps in gluing the different chromosomal arms. The chemical affects the gluing properties of these proteins and leads to the increase stickiness aberrations among the chromosomes. Also the separian protein molecule which helps in separating the two strands of DNA affect may become less functional and increases the stickiness among the chromosomes. The stickiness type of physiological aberrations leads to the production of different other type of physiological aberrations such as laggards, fragments,

bridge formation, strayed chromosomes, abnormal anaphase unequal distribution of chromosomes and abnormal metaphase stage. Laggards aberration were observed maximum in *Allium ascalonicum* which also suggest that chromosomes are much affected by the chemical and the chromosomes are unable to move towards the pole because of the maximum stickiness observed in the species. The other physiological aberrations such as strayed chromosomes, abnormal anaphase and abnormal metaphase have not shown an increasing or decreasing trend for the different concentration for the species. From the present data it has been observed that stickiness among *Allium* species was maximum and it seem normal kind of abnormality occurs in different *Allium* species.

Table 1: Physiological aberrations recorded in different *Allium* species (data are mean 5 of slides)

A.hookeri					
Concentration	**Control**	**Chromatin bridges**	**Chromo.breaks**	**Ring chromo**	**micronuclei**
500 ppm	88.2	0.2	0.2	0	1.6
1000 ppm		2.4	2	0	6.6
3000 ppm		1.6	0.8	2.6	35
A.ascalonicum					
concentration					
500 ppm	40.4	1.6	0.8	0.4	5.6
1000 ppm		0.4	1.2	0	0
3000 ppm		1	1.6	0	12.4
A.tuberosum					
concentration					
500 ppm	75.8	0.4	-	1	-
1000 ppm		0.8	1.2	1.4	18.2
3000 ppm		0.2	-	19	
A.chinense					
concentration					
500 ppm	43.8	0.4	0.8	0.4	1
1000 ppm		0.2	-	0.4	0.2
3000 ppm		0.6	-	-	9.6

Table 2: Clastogenic aberrations recorded in different *Allium* species (data mean of 5 slides)

A.hookeri						
Concentration	**Control**	**LAGGARDS**	**STICKINESS**	**STRY.CHRO.**	**AB.ANA**	**AB.META**
500 ppm	88.2	0.2	5.8	0.2	0	0.4
1000 ppm		2	8.2	2	3.4	0
3000 ppm		0.8	10.6	0.8	13.2	0.4
A.ascalonicum						
concentration	**Control**	**LAGGARDS**	**STICKINESS**	**STRY.CHRO.**	**AB.ANA**	**AB.META**
500 ppm	40.4	1.6	11	0.4	0.2	1.8
1000 ppm		4.8	19.2	0	0	0
3000 ppm		2.2	20.4	0	0	0.8
A.tuberosum						
concentration	**Control**	**LAGGARDS**	**STICKINESS**	**STRY.CHRO.**	**AB.ANA**	**AB.META**
500 ppm	75.8	1.4	13.4	0	0.2	-
1000 ppm		0.6	39.6	0.6	1	-
3000 ppm		0.4	10.8	0	0	-
A.chinense						
concentration	**Control**	**LAGGARDS**	**STICKINESS**	**STRY.CHRO.**	**AB.ANA**	**AB.META**
500 ppm	43.8	0.4	16	0.4	0.4	7.8
1000 ppm		-	14.2	-	0.4	0.8
3000 ppm		-	13.4	-	0.2	0.8

On the other hand the maximum stickiness of the chromosome in physiological aberrations induced may involve in the induction of clastogenic type of aberrations in the chromosomes of the species. The clastogenic type of abnormality occurs when stress affects the genetic material of the chromosomes of plant or animal species. The different types of clastogenic abnormality were observed such as chromatin bridges, chromosome breaks ring chromosome and micronuclei at different concentration. The chromatin bridge has shown increasing trend in *Allium chinense* but other three species does not show any increasing or decreasing trend at different concentration. It suggest that all the three concentration for *Allium chinense* are toxic and they are affecting the genetic material separian and gluing protein of the chromosome, the chromatin bridges remains in the cell division in the form of an

abnormality and they have capacity to produce abnormal cell or sterility in the organisms. The chromosomes breaks was increase from lower to higher concentration in *Allium ascalonicum* while *Allium tuberosum* and *Allium chinense* less affected than *Allium hookeri* the increase number of chromosomal breaks *Allium ascalonicum* suggest that the chemical is highly toxic or not suitable as compared to *Allium chinense*, *Allium tuberosum* and *Allium hookeri*. We may suggest that the chemical may not be used for any kind of trend in the *Allium ascalonicum* as it has chromosomal break clastogenic aberrations and there may be a chance to lose the genetic fragment or chromosome fragment during cell division which cannot be recovered back again. Similarly the ring chromosome clatogenic aberrations were observed in increasing trend from lower to higher concentration in *Allium hookeri* and *Allium tuberosum*. The highest concentration(3000 ppm) is highly toxic for the species as it induces maximum number of ring chromosomes. But the ring chromosomes may be utilised in both ways disadvantage and advantages type. The advantage type include that the concentration may be used to induce the chromosomal exchange with non-homologous pair. The disadvantage of these ring chromosomes is that the chromosomes translocate among themselves and increase the homozygous which reduces the plant vigour.

CONCLUSION

The clastogenic aberration form of micronuclei has shown increasing trend in the *Allium hookeri* from lower to higher concentration followed by *Allium ascalonicum* and *Allium chinense*. It seems that all the concentrations of SDS are highly toxic for the species. In the form of micronuclei aberrations micronuclei may be induce from the chromosomal breaks and in the successive cell division the break may remain in the cell in the form of nuclei. The fate of the nuclei may remain in the cell for little successive generation or produce different type of abnormality after binding with normal chromosomes or lost from the cell after successive cell divsion cycle.

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