

CLASTOGENICITY AND MUTAGENICITY POTENTIAL
OF BUTACHLOR

A Thesis

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in Partial Fulfillment

of the Requirements for the degree of
Master of Science in Biology

by

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CHAPTER 1

INTRODUCTION

Herbicides, despite their importance in agriculture, contribute to a variety of substances that are potential health hazards. Indiscriminate use of such substances could present the possibility of increased frequency of mutation. Spray application of an herbicide on weeds, for instance, increase the risks of genetic change on both somatic and germ cells. Moreover, residues of the chemical may remain in food and may be ingested by man. Effects of other herbicides as demonstrated on plant cells include chromosomal breakage, nuclear fragmentation and mitotic aberrations followed by structural rearrangement (Brian, 1964). In birds, it was found that eggs exposed even to small doses of a herbicide often develop into chicks with impaired learning abilities. Herbicide spraying in an area in New Zealand was believed to be the cause of a high incidence of neural tube defects and club foot (Sanderson and Rogers, 1981). Exposure to dioxin, another herbicide, causes chloracne, a skin disease, while there is also an evidence that it causes cancer in humans (Hay, 1982). Certain forms of herbicides known as amides had an effect on mitosis and caused chromosomal breakage in plant cells (Brian, 1964). A number of commercial herbicides are capable of inducing genetic change in laboratory cultures of bacteria and fungi. Induction of gene conversion at two

loci in the yeast, *Saccharomyces cerevesiae*, was also shown after treatment of herbicide preparations (Farry, 1973).

The use of herbicides is considered the most practical, effective and economical means of reducing weed problems and such method is widely used in rice plantation especially in developing countries (Moody and Estorninos, 1988). Machete, an herbicide used for weed control in wetland rice, *Oryza sativa*, contains butachlor as the active ingredient with a concentration of 600 grams per liter, and the solvent xylene with a concentration of 218 grams per liter. This herbicide is applied at 300 liters per hectare of puddled rice field. Butachlor is an organic substance which is a light yellow oil and very soluble in water and most organic solvents. It belongs to the amide group of organic substances with a molecular weight of 311.86 (Buckingham, 1982). The percentage composition is calculated to be: 65.47% Carbon, 8.40% Hydrogen, 11.37% Chloride, 4.49% Nitrogen, and 10.26% Oxygen (Winholz, 1983).

Review of Literature

A number of herbicides have been found to cause chromosomal aberrations. Such substances are considered mutagenic because they cause change in the genetic make-up of the cell. Mutagenic agents pose serious hazards to the human gene pool of present and future generations. It is

evident, however, that the mechanisms of induction of chromosome aberrations by chemicals and radiation are complex (Whitehouse, 1973). A chemical mutagen can act in various ways depending on its property and how it reacts with the nitrogenous bases of the deoxyribonucleic acid or DNA (Russell, 1980).

In humans, possible symptoms and signs as result of exposure to butachlor include convulsions and coma, and as irritant to the skin, gastro-intestinal and respiratory tracts (Dreisbach and Robertson, 1987).

A chromosome is considered a nuclear component endowed with a special organization, individuality, and function. The continuity of the chromosomal set contained in a cell is maintained by mitosis which takes place in a series of consecutive stages known as prophase, metaphase, anaphase and telophase. Figure 1 shows a diagram of mitosis in idealized cells having four chromosomes. At anaphase, each chromosome, composed of two sister chromatids, splits to form two daughter chromosomes which migrate to opposite poles of the cell. Finally, at telophase the daughter chromosomes at each pole become dispersed and two daughter chromosomes at each pole become dispersed and two daughter nuclei are formed (DeRobertis et.al. 1975).