Some properties of SENCOR (Metribuzin) and bases for variation of its effect on *Solanum nigrum* and *Solanum sarachoides*

A thesis presented in partial fulfilment
of the requirements for the degree of
Master of Horticultural Science
in Plant Science
at
Massey University

Amaranathan s/o Balasingham

1974

ACKNOWLEDGEMENTS

I express my sincere thanks to Professor J.A. Veale, Professor of Horticultural Science, Massey University for his supervision of this thesis.

I am also thankful to Mr D.A. Slade, Senior Lecturer, Department of Horticulture, Massey University, for suggesting this topic and for communications with the chemical companies on my behalf.

I would also like to thank Mr H. Neilson, Technician, Plant Pathology Department, Massey University, for photographing the stomatal imprints.

I am especially grateful to Mr H.S. Park, Ph.D. student, Department of Horticulture, Massey University for his genuine interest in this study, for useful suggestions, and guidance in statistical analysis of the data; also to my wife for her help throughout this study.

SENCOR was supplied by Henry H. York & Co. Ltd (New Zealand). The metabolites were manufactured and supplied by Frabenfabriken Bayer A.G. (Germany). The labelled material was supplied by Chemagro (U.S.A.). I acknowledge these companies for their material help.

ABSTRACT

In Part I of this study, the relative potencies of SENCOR and its metabolites have been investigated. SENCOR has been established as a potent Hill reaction inhibitor. The observed action of SENCOR and its metabolites are discussed in terms of structure/activity relationship.

The mechanism of action of SENCOR and one of its metabolites is compared with other known Hill reaction inhibitors. A scheme is then proposed for the mode of action of Hill reaction inhibitors.

In Part II the observed variation in the field, in the response of Solanum nigrum and Solanum sarachoides to SENCOR has been established as a phenomena of species selectivity.

From studies on uptake, distribution and metabolism of radioactive SENCOR it has been established that a restriction to movement of the herbicide from the xylem to the mesophyll occurs in Solanum sarachoides (tolerant species) while the material is distributed throughout the mesophyll in the susceptible Solanum nigrum. This restriction to movement into the mesophyll in the tolerant species has been confirmed by studies on the inhibition of rate of transpiration and from effects on stomata. SENCOR also appears to be metabolised to a greater extent in the tolerant species.

This study leads to the conclusion that the protection of the active centre, the chloroplasts, through restriction to movement of SENCOR into the mesophyll, combined with partial breakdown of the herbicide in the plant may be responsible for the tolerance of Solanum sarachoides to SENCOR.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

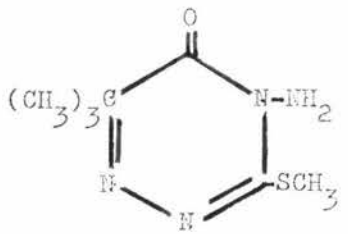
LIST OF PLATES

Chapter 1

INTRODUCTION

SENCOR, a pre-emergence and post-emergence herbicide is being developed by Henry H. York & Co. Ltd under licence from Farbenfabriken Bayer A.G. Its chemical name is 4-amino-3-methylthio-6-t-butyl-1, 2,4-triazine-5-one. Its chemical structure is:

SENCOR (metribuzin)



This compound has shown, effective control of many annual broad leaf and grass weeds when applied to corn, tomatoes, potatoes and legumes.(1).

Variation in control of two solanum species, i.e. Solanum nigrum and Solanum sarachoides have been observed (141). Therefore this project is an attempt to investigate whether this variation is due to species selectivity rather than an observed differential effect due to stage of growth difference.

In order to establish bases for selectivity, knowledge of mode of action and properties of the chemical is essential. As regards activity of SENCOR, only passing reference to it as having similar mode of action as uracil herbicides have been made in a technical paper (76). The metabolite "deaminated diketo" (Fig.1) of SENCOR has been alleged to possess the herbicidal activity (inhibition of photochemical reaction). This assumption is based on the observed structural similarity of this metabolite with that of uracil, a Hill

reaction inhibitor (83). However, structure activity relationship studies on inhibitors of photosystems provides theoretical support for SENCOR (a triazinon) itself to possess the herbicidal property.

Draber et.al. (50) have related the structure of triazinones with inhibitors of the Hill reaction. The chemical structure of triazinones fits into the scheme developed for herbicides with such a mode of action.

In such a case of uncertainity, it it necessary to establish the mode of action of SENCOR and also evaluate the relative potency of the primary product and the metabolites.

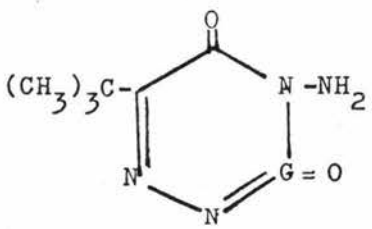
The tolerance of Solanum sarachoides to the herbicide may be due to the protection of active site (Hill reaction centre of photosystem II) by relative impermeability of chloroplast membranes.

In comparing the degree of inhibition of isolated chloroplasts of the two species, if difference in susceptibility occurs, then the selectivity must be a function of the chloroplast membrane itself. If, however, the degree of inhibition of the photosystems of the two species are similar then perhaps, tolerance is a function of some physiological or biochemical phenomena which may involve differential rate of uptake, distribution or metabolism of SENCOR. While, if differential rate of metabolism of SENCOR is evident, then it is also possible for these products to form conjugates and thus, prevention of translocation may be a basis for selectivity. Autoradiographic studies may establish evidence for such a selectivity.

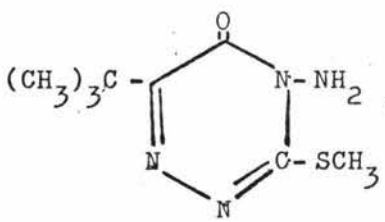
Full study of all factors will entail a detailed project of research which is almost impossible to be carried out single handed and within the duration of masterate studies; but as will be seen from this presentation, an attempt has been made to investigate some pertinent and important aspects.

Fig.1

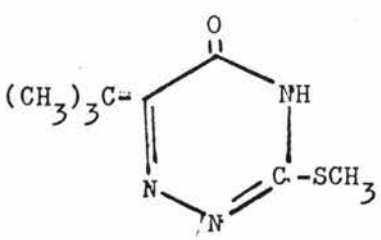
SENCOR and its metabolites



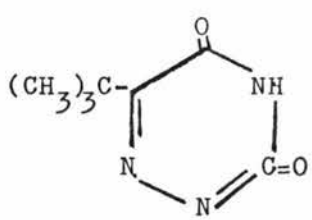
Diketo metabolite
(DK)



SENCOR active ingredient
(S)



Deaminated metabolite
(DA)



Deaminated Diketo metabolite
(DA DK)