SYMPOSIUM ON MODE OF ACTION OF HERBICIDES

Introduction

The first successful attempts to control undesirable plant species selectively with the herbicide 2,4-D were described in the early 1940's. Since that time, a wide variety of sophisticated herbicidal chemicals have been developed. Significant advances have been made in our understanding of the practical application and of the fate of these chemicals, but little concentrated effort has been made to understand their effect in the plant. Consequently, mechanism research has lagged behind other areas of herbicide research.

Two important principles have been elucidated in mode of action research. First, many herbicides act on biochemical processes that are probably unique to the higher plant. Photosynthesis was early recognized as a site of action. Second, herbicides act at more than one site. Consequently, a number of indirect effects have been observed with most herbicides.

This symposium was organized to consider the present status of research on herbicidal mechanisms. Outstanding authorities discussed recent advances in their respective fields. Nine papers were presented orally at the San Francisco meetings. A group of five papers is published here. Papers not published at this time include: Role of RNA Metabolism in the Action of Auxin-Herbicides by J. B. Hanson and F. Slife, Effects of Herbicides on Electron Transport and Phosphorylation Reactions in Chloroplasts and Mitochondria by D. E. Moreland and W. G. Blackman, The Relation of Metabolism to Mode of Action of Phenoxy Herbicides by D. G. Crosby and H. Tutass, and A Biochemical Basis for the Selective Herbicidal Action of 3,4-Dichlorobenzyl Methylcarbamate by R. A. Herrett. Persons desiring to obtain a complete set of papers are urged to contact the authors directly. Finally, it is hoped these papers will serve as a stimulus for new advances in mode of action research.

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Analysis of the Mode of Action of Herbicidal α-Chloroacetamides

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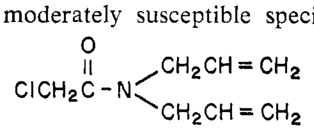
Selectivity of α-chloroacetamides is based on differential rates of metabolism or detoxification between sensitive and resistant plant species. However, physiological effects cannot be explained. Investigations have now focused attention upon protein synthesis as the general locus of interaction, although the reactivity of the α-chloroacetamides with nucleophiles suggests the possibility of multiple sites of action.

While the subject for discussion pertains to the mode of action of α-haloacetamides, it may be helpful to describe briefly the current understanding of the basis for selectivity of these herbicides.

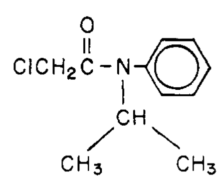
The two compounds that will be discussed in detail are shown in Figure 1. Both are pre-emergent herbicides used primarily in corn and soybeans, but they are also used in many other crops. They are especially effective against a wide spectrum of grassy weeds such as foxtail, bromegrass, cheatgrass, and crabgrass, and certain broadleaf weeds such as pigweed and lambsquarter.

UPTAKE AND METABOLISM OF CHLOROACETAMIDES BY GERMINATING SEEDS

Studies by Smith *et al.* (1966) defined the possible relationship between the degree of susceptibility of four plant species to α-chloroacetamides and differential uptake or metabolism of the compounds by the plants. The seeds used in these studies were corn, oat, soybean, and cucumber. Oat and cucumber seeds were representatives of moderately susceptible species, and corn



CDAA



PROPACHLOR

Figure 1. Structures of *N,N*-diallyl-2-chloroacetamide (CDAA) and *N*-isopropyl-2-chloroacetanilide (propachlor)

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