SYMPOSIUM ON DECOMPOSITION AND METABOLISM OF HERBICIDES

Introduction

The continuing and rapid development of new and effective herbicides required to meet the increasing demands of agriculture to feed an ever-expanding populace has led to a concomitant expansion in studies on the decomposition and metabolism of these herbicides. Such studies have made a significant impact upon our understanding of the manner in which nature and living systems cope with new inputs into their environment. These multidisciplinary investigations have given us new insights into the comparative biochemistry of plants, animals, and microbial systems, and provided us with more useful scientific rationale for the design of better herbicides. The research findings exemplified in this symposium should also permit us to develop a more precise and informed understanding of the influence of herbicides upon our environment and aid in the objective analysis of potential hazards.

The specific objective of this symposium was to cover recent developments regarding the decomposition and metabolism of the newer herbicides in plants and in soil, as well as to bring scientists up to date on the progress of metabolism and decomposition of herbicides in general. Consideration was given both to biological factors and to chemical and physical factors. Soil decomposition of herbicides was considered from the microbiological aspect as well as from purely physical aspects involving adsorption of herbicides in the soil environment. Photodecomposition of herbicides was also discussed since this phenomenon may play an important role in the nature of the nonbiological modification of herbicides, a factor that may be of considerable importance in the interpretation of "apparent biological" degradation.

The Pesticide Subdivision of the Division of Agricultural and Food Chemistry can be of real service to scientists by continuing to sponsor such interdisciplinary symposia in the area of pesticide metabolism, degradation, and mode of action.

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Significance of Atrazine Dealkylation in Root and Shoot of Pea Plants

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The major metabolite of atrazine in both roots and shoots of young pea plants was 2-chloro-4-amino-6-isopropylamino-*s*-triazine (compound I). Both roots and shoots were able to metabolize atrazine independently to compound I. The phytotoxicity of compound I was less than that of atrazine. The conversion of the highly toxic atrazine to the less toxic metabolite, compound I, and the accumulation of these compounds in the plant may be a mechanism resulting in intermediate susceptibility of pea plants to atrazine.

The major metabolite of 2-chloro-4-ethylamino-6-isopropylamino-*s*-triazine (atrazine) in mature pea plants was recently isolated and identified as the dealkylated product, 2-chloro-4-amino-6-isopropylamino-*s*-triazine (compound I) (*17*). A dealkylation product of 2-chloro-4,6-bis(ethylamino)-*s*-triazine (simazine) was also identified in the culture media of the soil fungus, *Aspergillus fumigatus* (Fres.), as 2-chloro-4-amino-6-ethylamino-*s*-triazine (*11*). Previous reports on metabolism of atrazine and simazine in higher plants have identified the major degradation products as 2-hydroxy-4-ethylamino-6-isopropylamino-*s*-triazine (hydroxyatrazine) and 2-hydroxy-4,6-bis(ethylamino)-*s*-triazine (hydroxysimazine) (*1*, *7*, *8*, *14*, *16*).

The tolerance of corn, *Zea mays* (L.), to atrazine and simazine is believed to be due largely to its ability to degrade simazine (*1*, *6*, *8*, *16*) and atrazine (*14*) to hydroxysimazine and hydroxyatrazine, respectively. Plants are believed to respond similarly toward atrazine and simazine. Other species besides corn have been reported to metabolize atrazine (*15*) and simazine (*7*) to their hydroxy derivatives. The ability of plants to convert the 2-chlorotriazines to their 2-hydroxy derivatives was reported to be correlated with the presence of a cyclic hydroxamate, 2,4-dihydroxy-3-keto-7-methoxy-1,4-benzoxazine (benzoxazinone) in plants (*7*).

Attempts have been made to explain intermediate susceptibility or tolerance among different species to the triazines. The amount of simazine absorbed does not determine susceptibility of a given species (*3*). A correlation between the amount of unchanged atrazine found in plants and susceptibility has been reported for several plant species (*15*). However, sorghum, a resistant species, did not metabolize simazine to hydroxysimazine (*7*) while the moderately susceptible pea plant rapidly metabolized atrazine to compound I (*17*).

In this investigation, the metabolism of atrazine in root and shoot tissues of young pea seedlings was determined. The significance of metabolism in different

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