Pesticide-Clay-Water Interactions

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I. INTRODUCTION

Pesticide behavior in soils is complicated by numerous interactions between the solid, liquid, and gaseous phases of soil, and between living and inanimate components. The complexity of the system is a hindrance to understanding the precise nature of these interactions. Adsorption of pesticides on solid surfaces in soils depends principally upon pesticide-water, pesticide-colloid, and colloid-water interactions, all operating simultaneously. Definition of these interactions is complicated by the wide range in physico-chemical properties of different pesticides, by the complexity of the colloid surface, and by the variable composition of the soil solution.

Although there is considerable value in statistically correlating the adsorption or biological activity of pesticides to specific soil properties (Sheef's, Crafts, and Drever, 1962; Day, Jordan, and Jolliffe, 1968), multiple regression techniques are sometimes limited by mutual dependence of factors which are required to be independent for valid statistical analysis. The direct effects of various factors are often obscured, and extrapolation of results from one set of variables to another is risky. In recent years much progress has resulted from careful study of well-defined, simplified systems which allow definitive analysis of specific interactions. Pesticide-clay-water systems with adequately characterized homoionic crystalline clays are an example of model systems which have been especially useful. The merits of crystalline clay minerals, such as montmorillonite and kaolinite, as adsorbents are: (i) they are common constituents of real soils, (ii) they have been thoroughly characterized by numerous techniques such as X-ray diffraction, differential thermal analysis, and electron microscopy, and (iii) they can be readily obtained in relatively pure form. The principal limitation of using these clay minerals in adsorption studies is the likelihood that soils have native organic matter and amorphous inorganic material sorbed on the surfaces of crystalline clays so that measurements of pesticide adsorption in pure clay mineral systems may not be applicable to soils (Hance, 1969; Hamaker & Thompson, 1972). This limitation must be kept in mind when applying results from crystalline clays to soils, but the advantages of using crystalline clays in pesticide adsorption studies to elucidate the mechanisms of adsorption have been amply demon-

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