Volatilization and Vapor Transport Processes

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Volatilization is the dominant process that controls the dispersal of many pesticides into the general environment as well as the length of their effective lifetime in the target area. The factors that influence volatilization are, therefore, of major interest for understanding the role it plays in controlling the efficiency and environmental distribution and impact of pesticides.

In this chapter, we discuss the physics and chemistry of the volatilization process. The discussion is confined to processes acting at or close to the surfaces of the soil or plant leaves and in the atmosphere a few meters above them. The long-distance transport of pesticides in the atmosphere, including their chemical and photochemical stability in air and their rates of redeposition, touches upon more general aspects of environmental chemistry that will not be discussed here in detail.

Immediately after application, pesticides begin to disappear from the target area either by chemical degradation with the formation of new compounds or by physical removal by the action of air or water. Chemical degradation reflects the stability of the compound in the chemical or biochemical environment existing on the soil or plant surface. Degradation reactions can be predicted from data obtained under controlled conditions in the laboratory or greenhouse because they are sensitive to environmental factors such as temperature, light intensity, or humidity. When such data are used to predict the rate of disappearance of the residues in the field, it is often found that physical losses must also be taken into account. The rate of physical loss is often faster than chemical degradation.

Rates of residue removal by air or water are difficult to predict because they are highly dependent upon rainfall, weather patterns, the soil moisture regime, and microclimatic conditions at the soil or crop surface. Losses of residues in water by surface runoff, movement with eroding soil or downward leaching are discussed elsewhere. It may be noted that, except in special circumstances, the total seasonal losses in runoff rarely exceed 5 or 10% of...