POLYCHLORINATED BIPHENYL UPTAKE AND TRANSLATION BY SPARTINA ALTERNIFLORA LOISEL.

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Abstract. This paper presents the findings of initial investigation of the role of Spartina alterniflora Loisel. in the movement of chlorinated hydrocarbons. 14C-polychlorinated biphenyls and technical Aroclor® 1254 were used for the determinations. The findings demonstrate that Spartina accumulates 14C-radioactivity from sand and organic mud soil systems treated with 14C-PCB's. These findings also demonstrate that this plant has the capacity to accumulate 14C-radioactivity to levels elevated above that in the treated soil. Other experiments with Aroclor® 1254 demonstrate that congeners of Aroclor® 1254 are present in Spartina stem and root extracts. These experiments also suggest that the chlorinated hydrocarbon uptake process is modulated by the plant and that this results in selective congener uptake. The selectivity appears to be for the lesser chlorinated components of the commercial mixture. Overall, this study suggests that Spartina may act as an initial vector for mobilization of sediment bound chlorinated hydrocarbons to the estuarine food chain.

1. Introduction

Polychlorinated biphenyls (PCB's) are chlorinated hydrocarbons which are characteristically toxic to a broad range of organisms and are highly persistent in the environment. Numerous reports and reviews indicate that these anthropogenic molecules contaminate wetlands throughout the world (Dustman and Stickel, 1966; Butler, 1967; Moden, 1969; Walsh, 1972). Further, it has been demonstrated that chlorinated hydrocarbons are subject to biomagnification and concentrate in organisms higher in the estuarine food chain (Woodwell et al., 1967). Although several pathways for faunal uptake of chlorinated hydrocarbons have been investigated (Grezenda et al., 1970; Macek and Korn, 1970; Scura and Theilacker, 1977), little information exists pertaining to the role of saltmarsh plants in the movement of these materials in the ecosystem.

Spartina alterniflora Loisel. (salt marsh cordgrass) is the dominant vascular plant of temperate saltmarshes along the Atlantic and Gulf coasts of the United States. During recent years, productivity, energy flow, and nutrient flow studies of the estuarine system have suggested the importance of Spartina to the estuarine community, both as a food source and as habitat (Teal, 1962; Pomeroy et al., 1972). Although little of the live material is consumed directly, Spartina has been suggested as a major source of detritus, providing carbon, i.e., energy, and essential nutrients for the estuarine detrital food web (Odum and de la Cruz, 1967). Thus, toxic or hazardous substances which enter and

accumulate in estuaries may be introduced into the detrital food web, if taken up and accumulated by *Spartina*.

Much of the work on the uptake of chlorinated hydrocarbons by plants is a result of interest in a possible direct vector for introduction of these compounds into the human food chain through accumulation by agricultural plants (United States Department of Agriculture, 1960). These investigations have stressed primarily organochlorine pesticides, as these are intentionally applied to agricultural fields and tend to accumulate there in the soil. This can lead to bioaccumulation of pesticide residues in crop plants to levels which may exceed established tolerance limits (Suzuki et al., 1973).

Uptake and translocation of chlorinated hydrocarbons by *Rhizophora mangle* L. (red mangrove) has been investigated under laboratory conditions (Walsh et al., 1974). Additionally, chlorinated hydrocarbon residues have been detected in samples of natural coastal vegetation, such as *Ruppia maritima* L. and *Cladophora* sp. Kutzing (Croker and Wilson, 1965), *Spartina patens* (Aiton) Muhl. (Woodwell et al., 1967), and *Rhizophora mangle* L. and *Thalassia testinudum* Konig (Reimold, 1975).

Marsh plants and soils were surveyed for 18 specific chlorinated hydrocarbon compounds, including polychlorinated biphenyls, in an effort to compare chlorinated hydrocarbon levels between natural marsh sites and constructed marsh sites in the James River, Virginia (Lunz, 1978). Nine of the suspected compounds were identified, but most samples yielded below detectable levels for the suspected residues. Based on these findings, it was concluded that chlorinated hydrocarbon compounds levels in marsh soils were not correlated with the occurrence or concentration of these materials in plant tissues.

Data were collected, during the development of a field bioassay for detecting contaminant uptake from dredge material, that indicated the marsh plants *S. alterniflora* and *Distichlis spicata* (L.) Greene may have taken up PCB material from the substrate (Wolf et al., 1978). Although the data were sparse and the duration of the test short, these investigators indicated that their findings with the Bioassay Experimental Test (BET) unit suggested that these plants were acting as vectors for the transfer of PCB compounds to the estuarine food web.

This paper presents the findings of a preliminary investigation of the role of *S. alterniflora* in the movement of chlorinated hydrocarbons under controlled conditions. The initial portion of this study was conducted to document trends of uptake and accumulation of $^{14}$C-radioactivity, originally applied to different soil systems as $^{14}$C-polychlorinated biphenyl, by *S. alterniflora*. The later portion of this study was conducted to confirm that PCB molecules could be extracted and identified from *S. alterniflora* tissue samples.

2. Methods

2.1. Soil and Soil Preparation

Two soil systems, creek-delta mud and river bottom sand, were used in this study. Creek-delta mud (mean organic matter content $28.8\% \pm 2.1; n = 10$) was excavated from