Re-Examining the Relationship between Plant Uptake of Organic Chemicals and Octanol Water Partition Coefficients

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The uptake of most xenobiotic organic compounds is believed to be passive. Compounds in the transpiration stream must pass through lipophilic root membranes before being translocated to the shoot. The ability of an organic compound to be translocated has typically been described by a transpiration stream concentration factor (TSCF), the ratio between a compound's concentration in the xylem to that in the solution outside the root. Bell-shaped curves relating TSCF to the lipophilicity of a chemical as described by the octanol/water partition coefficient (log Kow) have been reported for several small sets of chemicals. The shape of these curves implies that there is an optimal lipophilicity for translocation, with highly polar or lipophilic compounds not expected to be significantly translocated. However, recent experimental data suggests that these relationships may not be appropriate, especially for neutral, highly polar organics. To re-examine the applicability of bell-shaped relationships between TSCF and log Kow, more than 100 values were compiled from the literature. Using all values, no significant relationship between TSCF and Log Kow was observed. However, separating the literature TSCF values into groups based on experimental approach gave a statistically significant linear relationship (low log Kow high TSCF) for pressure chamber derived TSCF values but not for intact plants. The lack of relationship may be due to differences in exposure duration and plant age which are minimized in pressure chamber approaches. Using only the TSCF values generated in our laboratory, significant linear relationships with log Kow were observed for pressure chamber and intact plants both separately and when combined. Overall, the results suggest that the commonly used bell-shaped relationship between TSCF and log Kow is likely not appropriate for neutral, highly polar organics. However, until data is generated in a consistent experimental manner, the ability to improve existing TSCF relationships will be limited.

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