Chapter 4A

Root Growth and Activity

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Roots are an integral part of all higher plants, and recent research on root-shoot communication (Davies & Jeffcoat, 1990; Passioura, 1994, see Chapter 13A) demonstrates, at a biochemical level, how the integration of growth and function in roots and shoots is effected. Much of this work has been conducted with individual plants, but its practical manifestations in crop performance is clearly visible. After the initial seed reserves have been utilized, the size and activity of the root system determines both the rate at which the shoot system can grow; and this, in turn, affects the subsequent rate of growth of the root system itself. This “functional equilibrium” was initially described by Davidson (1969) as

\[
\text{Root mass } \times \text{ specific root activity} = \text{shoot mass } \times \text{ specific shoot activity}
\]

and has been elaborated by several workers (e.g., Thornley, 1972; Charles-Edwards, 1984) attempting to provide a quantitative interpretation of this relation. This model is empirical and does not explain the mechanisms by which assimilates are partitioned. Nevertheless, it draws attention to the importance of roots in crop production in their function as absorbers of both water and nutrients.

The amount of dry matter \( (W) \) produced by crops per unit area can be written as

\[
W = \int \text{RUE} \cdot f \cdot S \, dt
\]

[1]

where RUE is the efficiency with which intercepted light is converted to dry matter, \( f \) is the fraction of the incoming radiation intercepted by the canopy, \( S \) is the amount of incoming radiation per unit area, and \( t \) is time (Monteith, 1977). This relation is often used as the basis of models to describe the potential dry matter production of crops. However, for dry matter to accumulate two requirements must be met. First, exchange of \( \text{CO}_2 \) through