Gaseous Exchange in Crop Stands

EDGAR LEMON

Agricultural Research Service, USDA
Ithaca, New York

I. PROBLEMS OF MEASUREMENT AND UNDERSTANDING

Man through the ages has evolved a strategy, albeit empirical, of manipulating the environment and the plant to his advantage. Practices such as fertilizing the soil, irrigation, weed control, and plant breeding and selection are common. Nonetheless, concentrated and coordinated efforts to understand the mechanisms controlling the whole soil-plant-atmosphere continuum is a new approach to finding new ways to favorably manipulate the whole system as well as predict response.

Conceptually and experimentally it has proven advantageous to view the total system in terms of energy, momentum, and mass exchange. This makes sense because in the first instance the foundations of crop production and water use are based upon two solar energy conversion processes—photosynthesis and evaporation. In the second instance, the momentum exchange of the wind creates the necessary turbulent ventilation to diffuse heat, water vapor, carbon dioxide, and oxygen. Of course, all of these exchange processes are driven by a common energy source—the sun.

My subject in this paper focuses on the ventilation of crop stands. We shall be mainly concerned with the turbulent diffusion of the physical properties of the air. The movement of air in crop stands has relevance to photosynthesis and respiration through the exchange of carbon dioxide and oxygen with the atmosphere. It has relevance also to transpiration through the exchange of water vapor and heat. Over the past 5 years we have taken advantage of the physics of turbulent diffusion to measure the rates of gaseous exchange layer-by-layer within the cano-

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