CHAPTER 8B

Crop Manipulation for Efficient Use of Water: Inadvertent and Intended Manipulations of Crop Water Use

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I. INTRODUCTION

Changes in crop water use may occur through inadvertent modification of the atmosphere, or by intentional modification of plant traits. This section briefly discusses how crop water use might respond to atmospheric enrichment with CO₂, and how manipulations of water use by plant breeding might be achieved.

Our current framework of crop manipulations to achieve efficient use of water has been developed by decades of research on crop growth and agronomic practices. Despite our confidence in these principles, we have little understanding of whether they will serve agriculturalists as reliably in the future as they have in the past. One reason for this uncertainty is the inadvertent and irreversible changes that humankind is making in the earth’s atmosphere.

II. CARBON DIOXIDE ENRICHMENT, PLANT GROWTH, AND WATER-USE EFFICIENCY

The CO₂ concentration of the atmosphere has risen about 1.2 ppm annually for the past 20 years because of increased combustion of fossil fuels and accelerated deforestation of the tropics. It is now conservatively predicted (Kellogg, 1979; Rotty, 1979) that the atmospheric CO₂ concentration in 50 years will be 50–100% greater than the present value of 330 ppm, and the consequences of this enrichment on growth and water use over the life cycle of the crop are difficult to anticipate. Studies of short-term CO₂ enrichment of the atmosphere around individual plants or leaves show that a doubling or tripling above ambient levels stimulates CO₂ exchange and rates of growth and development (Ford & Thorne, 1967; Akita & Moss, 1973;