I. INTRODUCTION

Research into plant responses to soil water appears to be of only recent origin despite the antiquity, importance, and almost world-wide occurrence of irrigation. Even now this research is on a comparatively small scale.

The first experimental demonstration of the essential part that soil water plays in plant growth is generally attributed to Van Helmont (1577–1644) in his classical experiment with a potted willow tree (Salix sp.). Almost 100 years later John Woodward (1699) published the results of his investigation into the quantitative relationship between the increase in plant weight of spearmint (Mentha spicata var. viridis) and the amount of water transpired. He clearly showed that the composition of the water applied affected the plant response and this might well be considered the first demonstration of nutritional effects on the efficiency of water use. At the same time Stephen Hales (1677–1761) was publishing the first quantitative demonstration of the effect of both climatic and plant factors on the intensity of water loss by transpiration.

Field research into crop water relationships started early in this century after the introduction of irrigation farming in the arid western and southwestern states of the USA (Widstoe and Merrill, 1912). The foundations of modern research into irrigation water requirements followed Veihmeyer’s work (1927) which showed the impossibility of maintaining a constant soil water content around the roots of transpiring plants. Veihmeyer and Hendrickson’s view (1929, 1950) that soil water is equally available for crop growth and transpiration over the entire range of available soil water between field capacity and permanent wilting percentage was widely accepted until the early 1940’s. However, a number of later experiments showed that plant growth and transpiration decreased before the wilting point was reached and, in some cases, a clear dependence between these plant responses and soil water potential was established (Wadleigh and Ayers, 1945). An analysis (Stanhill, 1957) of some 80 experiments on the effect of the so-called “available soil water” (that held between field capacity and wilting point) on growth showed that the majority of results did not favor Veihmeyer’s views that water was equally available for growth.

These findings, however, were not able to provide a basis for drawing up irrigation programs that would maximize yields and minimize water application, and it became increasingly clear that the relation between plant growth, crop yield,