CHAPTER I

INTRODUCTION

The importance of the relation of the state of water in the soil surrounding plant roots to the state of water in plant leaves has long been recognised. In fact, the supply of water to the plant, on the average, must equal its demand. The movement of water from the soil through plant to the atmosphere follows a gradient of potential energy (27,88). Water transport to the root system is again a function of soil water potential gradient, capillary conductivity of soil and root absorption area. As the soil water potential declines, the capillary conductivity decreases rapidly. As a consequence, the resistance to water movement in the soil limits the rate of water uptake by roots (30). Quantitative information on capillary conductivity and diffusivity of water in soils makes it possible to evaluate the water flux from soil to plant. Lack of progress has been due to meagre quantitative information about the water transmitting properties of soils especially for many Indian soils.

Philip (69) proposed the concepts of intrinsic-sorptivity and diffusivity as soil parameters which are the functions of soil geometry and independent of the infiltrating liquids. Farrell (24) criticised Philip's concept and suggested that the liquid properties such as surface tension, viscosity and contact angle are also associated with soil geometry and therefore should be considered in evaluating the intrinsic sorptivity and diffusivity. The intrinsic-penetrability and intrinsic-diffusivity were evaluated in order to obtain the actual magnitude of their values.

The rate of flow is determined by the magnitude of the potential gradient and the resistances to water movement in the soil plant atmosphere continuum. It is usually assumed that as the water deficit increases in the ambient environment of the plant, the water potential in the plant decreases thereby increasing the potential gradient resulting in more absorption of water. Recently Lang and Gardner (50) reported that the decrease in plant water potential caused little or no increase in water flux into the plant. Furthermore, the contribution of either the soil properties or the atmospheric conditions towards the water supply to plant roots is also not well known. It is thus evident that there is a gap in our understanding of the mechanism of water flux from soil through plant to air. Therefore, the problem is mainly of characterising soil-plant-environment systems quantitatively in terms of their water relations so that interpretation can be made to predict water movement in response to the potential gradient developed in the whole system. The present investigation was carried out to meet the following objectives:

(A) Quantitative assessment of flow parameters such as

1. Unsaturated hydraulic conductivity
2. Intrinsic-penetrability and
3. Intrinsic-diffusivity.

(B) Study of the influence of aforesaid flow parameters and energy status of plants on water flux. These would include

1. Transpiration
2. Leaf water potential and
3. Relative water content.

(C) Theoretical analysis of water flux and its comparison with observed flux.