

## INTRODUCTION

The production of wheat needs to be doubled by the end of twentieth century when India faces a target of 225 million tonnes of food grains. To attain this target the potential yield of the dwarf genotype, which has brought wheat revolution in India, should be fully exploited. It is an uphill task as only 56 per cent of the area under wheat is irrigated (Rao, 1978). With low river water flows, and limited available ground water supplies during winter and summer months, a high yield potential and water use efficiency (WUE) can only be attained if the available irrigation water is optimally allocated based on actual water requirement, contribution of stored soil water, and susceptibility characteristics of the crop. In practice, irrigation water for wheat is scheduled by its critical physiological stages of which the crown root initiation is the most vital one followed by jointing, flowering and grain filling (Gautam et al, 1968 ; Sekhon et al, 1968). The production function can be optimised by applying fewer irrigation only at the highly susceptible stages. Frequent irrigations at all phenological stages following a heavy presowing irrigation may decrease the WUE by increasing the water expense and fewer irrigation after a light pre-sowing

irrigation may lower the WUE by decreasing growth and yield (Prihar et al, 1976).

Growth and yield of crops are directly related to plant water use in dry land areas (Hanks et al, 1968). When soil water is not limiting the crop water use remaining at or above potential evapotranspiration is strongly influenced by micrometeorological condition. However, when soil water is limiting, the water use remaining at or below potential evapotranspiration, is related more to soil water availability than to micrometeorological parameters (Taylor, 1960, Penman et al, 1967). Water use by crop plants depends on their ability to extract water from soil overcoming the resistances in soil-plant-atmosphere continuum. The capacity of plant root system in their entirety to meet transpirational demand is in part determined by their gross morphological nature and extent, and in part by the specific impedance exhibited at the point of absorption (Denielson, 1967).

The water use and growth of crop plants are manifestations of leaf water relations that undergo diurnal and seasonal variations in response to meteorological and soil water conditions. Because of diurnal variation in evaporativity water extraction lags behind transpiration and leaf water dependent parameters namely leaf water potential ( $\psi_L$ )

leaf diffusion resistance and canopy temperature oscillate diurnally even in a managed agro-ecosystem. However, with limiting soil water, the lowering of midday  $\Psi_L$  increases further and induces stomatal closure inhibiting transpiration and carbon dioxide assimilation. When flag leaf water potential falls below  $-3.3$  MPa during panicle emergence stage of wheat, net photosynthesis and transpiration decrease linearly with decreasing  $\Psi_L$  (Johnson et al, 1974). The drought induced stomatal closure raises the canopy temperature which thus monitors the plant water stress in response to soil water deficit. As soil water deficit intensifies further  $\Psi_L$  lowers to a threshold value at which stomata close completely and photosynthesis ceases. Likewise, the recovery of photosynthesis after rewatering is also related to recovery of stomatal diffusion resistance at tillering and heading stages of wheat (Kirkham and Kanemasu, 1983). Once suppressed the photosynthesis rate however, never recovers fully to its prestress level as does stomatal resistance.

A comprehensive knowledge on the patterns of leaf water relations and photosynthesis in response to periodic soil water deficit and microclimate thus help in understanding the growth relations of the crop under environmental stresses and in optimising the allocation of irrigation water.

The changes in leaf water relations and photosynthesis in response to soil water deficit are greatly modified in tropical region when temperature plays an added role in enhancing the evaporative demand and raising the amplitude of the diurnal oscillations of leaf water dependent parameters. Sustention of photosynthesis and water use due to the osmotically regulated pressure potential in leaf makes the phenomena still more complex in tropical and subtropical regions. The adverse effects of soil water deficit on leaf water relations and photosynthesis of wheat plants in these regions are further accentuated by low water supplying capacity of the soils and abrupt rise in evaporative demand in late tillering and flowering stages. The latter type of situation prevails in the alluvial soils of Punjab. A little is known about the modifying influences of soil water deficit on water relations and dry matter production of the pre-nonstressed wheat plants under changing conditions of climate in northern India. The present investigation was therefore, conducted in lysimeters and field at Punjab Agricultural University, Ludhiana, Punjab, India, during the crop growing season of 1981-82 and 1982-83 to assess the diurnal/daytime changes in leaf water potential, leaf diffusion resistance, canopy temperature, photosynthesis and translocation, water use pattern as well as of growth and yield attributes of wheat in response to soil water deficit imposed at late tillering and flowering stages.