INTRODUCTION

The sessile nature of plants has forced the evolution of several specific sensory and adaptive mechanisms, to adjust to the exigencies imposed on them by environmental fluctuations. The most important among the environmental factors are light, water and temperature, for which plants have evolved specific adaptive mechanisms. Light is a must for the survival of plants, to drive photosynthesis, where light is used as a source of energy. In addition, plants also use light as a source of information by detecting its direction, duration, and spectral quality.

Plants estimate the duration of light by responding to the length of the day, a phenomenon called photoperiodism, which also provides the plant with reliable information about the passage of the seasons (Shropshire and Mohr 1983). Several morphogenetic events in plants such as flowering, dormancy, formation of storage organs etc., are known to be initiated by photoperiodic stimulus.

The perception of the direction of light yields important information, enabling plants to optimize their position in the natural environment by appropriate orientation movements, called phototropism. Most of the photosynthetic mobile algae can move towards a favorable, or away from a harmful light, a phenomenon called phototaxis. Phototropism as well as phototaxis are effective mechanisms of movement to optimize the availability of light for plants.

Plants have also evolved mechanisms to sense the spectral quality of light impinging on them. Since plants largely use the blue and the red wavebands of light in photosynthesis, the transmitted or the reflected light in plant canopies is rich in the far-red region of the spectrum. The perception of enriched far-red light initiates adaptive mechanisms in plants to offset the disadvantage of growing in shade or close to other plant species.

To detect and coordinate all these light mediated physiological responses, plants have evolved specialized photoreceptors. These photoreceptors detect the light spectrum and adjust the growth and development of plants according to the changes in the environment. To date, three groups of photoreceptors have been detected which specifically sense UV-B (280-320 nm), UV-A/blue (320-500 nm) and red/far-red
regions of the spectrum. It is believed that these three groups of photoreceptors act both independently as well as cooperatively with each other.

Blue light plays a role in directional responses—phototropism, morphogenic responses—inhibition of hypocotyl elongation, movement of guard cells and biosynthesis of pigments. Though the biochemical nature of this receptor is not known, a gene responsible for some of the blue light mediated responses has recently been cloned from the hy4 mutant of Arabidopsis (Ahmad and Cashmore 1993). The molecular nature of other blue absorbing photoreceptors is not known. The molecular identity of UV-B receptors has not yet been elucidated. Several physiological responses are known to be specifically mediated by UV-B photoreceptors like phototropism (Baskin and lino 1987), hypocotyl growth (Ballaré et al., 1991) and hormone inactivation (Tevini 1991) etc.

In contrast to the above two groups of photoreceptors, the molecular identity of the photoreceptor perceiving the red/far-red region of the spectrum has been known since 1959, when it could be detected in the crude extracts of maize seedlings by Butler et al., (1959), who named it as phytochrome. Phytochrome has been studied extensively both at the biochemical and molecular levels. Phytochrome is a biliprotein, blue in color, with a monomeric molecular weight of about 116-127 kD, and has an open chain tetrapyrrole as a chromophore (Furuya 1993; Pratt 1995). Phytochrome in plants principally functions to monitor the duration of day length and change in the spectral quality of light. It is involved in several morphogenic responses throughout the life cycle of plants.

It is known that several light mediated physiological responses like hair formation on epidermis, anthocyanin induction in the sub-epidermal layer, stomatal opening in guard cells, chlorophyll formation in mesophyll and bundle sheath cells are restricted to a specific cell or cell layer. Apparently, these responses are likely to be triggered by the photoreceptor located within these cells or cell layers. However, the exact location of the photoreceptor and the relationship between the level of the photoreceptor and the physiological response is not established clearly. In the case of phytochrome, where studies have been carried out about its distribution, the amount of phytochrome was found to be more in the young meristematic cells. It is however not
clear, if such a localization has a direct bearing to its role in growth regulation, but preliminary evidence has favored the idea of site specific action of phytochrome.

The advent of recent techniques of molecular-genetic analysis has revealed that the red/far-red sensing photoreceptor consists of several sub-species (Pratt 1995). Even the diminutive Arabidopsis plants possess five genes of phytochrome, which perform discrete functions to regulate the photomorphogenetic phenomena. The discovery of multiple phytochrome species has necessitated the examination of the mode of the action and distribution of each of these species in plants.

Only a limited information is available regarding the comparative distribution of different phytochrome species in plants. Most of the earlier studies have examined only the distribution of the phytochrome species which is predominantly present in etiolated tissue. In the presence study, the distribution of two species of phytochromes was examined using immunochemical methods. The study was also directed towards deciphering the interrelationship between the spatial and temporal expression and the distribution pattern of two phytochrome species namely phytochrome A (light-labile) and phytochrome B (light-stable) in a monocot and a dicot species. In addition, attempts were made to rescue phytochrome to its spectrally active form in the aurea mutant of tomato using the exogenously supplied chromophore, phycocyanobilin.