Chapter 1: Introduction
Light is arguably the most important factor for plant growth and development. (Kendrick and Kronenberg, 1994; Deng and Quail 1999; Quail 2002). The crosstalk of light signaling with other signaling cascades is still at its infancy. A promoter determinant, C/DRE, which is known to respond to low temperature, has been shown to be involved in phyB mediated light signaling to cold-induced gene expression (Kim et al., 2002). Phytochrome mediated light signaling has recently been demonstrated to be involved in the regulation of $TOP2$, one of the components of DNA replication and cell cycle machinery (Hettiarachchi et al., 2003). Using studies with Arabidopsis mutants affected in light perception, it was recently shown that phytochrome signaling interacts with salicylic acid (SA) signal transduction (Genoud et al., 2002). Weatherwax (1996, 1998) earlier demonstrated an interaction of light and ABA in the regulation of plant gene expression in Lemna gibba. Although these studies indicate possible crosstalk between signaling pathways, no transcription factor has been reported thus far, to our knowledge, which has been demonstrated to cross talk between light and other signaling pathways.

Higher plants, such as Arabidopsis thaliana, have several photoreceptors that are specific to a specific wavelength of light. Arabidopsis seedlings are genetically capable of following two distinct developmental pathways: skotomorphogenesis or etiolation in the dark, and photomorphogenesis or deetiolation in the light (von Arnim and Deng, 1996: Fankhauser and Chory, 1997). During skotomorphogenic development seedlings grow with long hypocotyls, small and closed cotyledons with apical hooks, and the expression of light inducible genes is significantly reduced. Upon exposure to light, seedlings cease rapid elongation of hypocotyls, chlorophyll and anthocyanin biosyntheses are initiated with the formation of true leaves, and the light inducible genes are upregulated. (McNellis and Deng, 1995; von Arnim and Deng, 1996).

Several photomorphogenic promoting positive regulators have been identified in light signaling pathways. HY5 is the first genetically defined transcription factor in light signaling pathways. A similar bZIP protein, HYH has been reported recently, mutation in which leads to blue light specific partial etiolation (Holm et al., 2002). LAF1, a MYB protein, has been shown to be involved in far red light mediated signaling (Ballesteros et al., 2001). Two other MYB proteins, LHY and CCA, are involved in circadian rhythm (Schaffer et al., 1998; Wang and Tobin 1998). Mutations in bHLH protein,
HFR1/REP1/RSF1, lead to an etiolated phenotype only in the far red light (Fairchild et al., 2000; Soh et al., 2000; Spiegelman et al., 2000). Two other bHLH proteins, PIF3 and PIF4, have been shown to be involved in phytochrome mediated transcriptional regulation. Furthermore, it has been demonstrated that phyB interacts with the G-box bound PIF3 (Ni et al., 1998).

Mutational studies have recently shown that PIF3 negatively regulates phyB mediated inhibition in hypocotyl elongation (Kim et al., 2003). There are other light specific repressors investigated in the light signaling pathways for example, SUB1 and SPA1. Whereas SPA1 acts in phyA mediated signaling, SUB1 is a repressor of far red and blue light mediated signaling pathways. Earlier a set of repressors, COP/DET/FUS, has been reported, mutation in any of these genes results in deetiolation in the dark with derepression of light inducible genes (Deng and Quail, 1999). Recent studies have revealed that COP1, acts as an ubiquitin ligase, helps to degrade the transcription factors such as HY5, HYH and LAF1 in the darkness (Osterlund et al., 2000; Holm et al., 2002; Soe et al., 2003). Furthermore, it has been demonstrated recently that SPA1 interacts with COP1 and modulates the degradation of HY5 and LAF1 (Saijo et al., 2003; Soe et al., 2003). It is worth mentioning here that although red and far red light specific repressors (PIF3 and SPA1, respectively) in light signaling pathways have been identified, no such repressor has been reported thus far that acts only in BL specific manner.

Four light responsive elements (LREs) G, GATA, GT1, and Z-box are commonly found in the minimal light responsive promoters and have been demonstrated to be critical for the light regulated activity (Tobin and Kehoe, 1994; Terzagi and Cashmore, 1995; Millar and Kay, 1996). G, GATA, and GT1 LREs have been investigated in some detail with context to light mediated regulation, and the identification of trans-acting factors specifically interacting with these LREs. However, the corresponding information is not available about the Z-box. In this thesis the following questions have been addressed to determine the regulation of Z-box in light signaling pathways:

1. How the Z-box containing promoters are regulated by various components of the light signaling pathways.
2. Whether there is any Z-box binding factor (ZBF) present in Arabidopsis thaliana.
3. What is the in vivo function of ZBF in photomorphogenesis?