Introduction

Legumes play an important position in human diet as they are the major sources of protein. Besides being rich source of protein they are also important for sustainable agriculture as they improve physical and chemical properties of soil and function as mini nitrogen factory. Among the leguminous plants soybean (*Glycine max* (L.) Merr. is commonly cultivated and used for different purposes. It is an important global crop and native to South East Asia. It is an annual plant that may vary in growth, habit and height (Plate IB). Cultivation of this plant is greatly hampered due to biotic and abiotic stresses. Soybeans are hot season annuals and the plants are more sensitive to cold season.Optimal temperature requirements for soybean cultivation ranges between 25-30°C.

Lentil (*Lens culinaris* Medik), a legume, is a bushy annual plant grown for its lens-shaped seeds (Plate I A). Lentils contain high levels of proteins, including the essential amino acids isoleucine and lysine, and are an essential source of inexpensive protein in many parts of the world for those who adhere to a vegetarian diet and are widely used in India. Apart from a high level of proteins, lentils also contain dietary fiber, folate, vitamin B_1, and minerals. Lentils are relatively tolerant to drought and are grown throughout the world. They are cool season annuals and are sensitive to high temperatures. About a third of the worldwide production of lentils is from India, most of which is consumed in the domestic market. However, productivity is seriously hampered by narrow genetic base of the presently cultivated varieties and losses due to the biotic and abiotic factors (Tickoo et al.2005).

Abiotic stresses such as drought, high and low temperatures, salinity etc., occur locally and exhibit variation in occurrence, intensity and duration. They generally cause reduced crop productivity. Among these abiotic stresses temperature is one of the most important environmental stress that a plant encounters and it is also a major factor limiting the growth of plants. Temperature stress, either as heat, cold or freezing is a principal cause for yield reduction in crops (Boyer,1982) and reactive oxygen species (ROS) generated by these stresses have been shown to injure cell membranes and proteins (Queiroz *et al.*, 1998; Keshavkant and Naithani, 2001; Larkindale and Knight, 2002) . Temperature stress can have a devastating effect on plant metabolism, disrupting cellular homeostasis and uncoupling major physiological processes (Suzuki and Mittler, 2006).

Plate I: (A): Growth of *Lens culinaris* (lentil)
(B): Growth of *Glycine max* (Soybean) in experimental field.

Elevated temperature stress is one of the major factors limiting the growth of plants as it adversely affects normal physiological processes such as photosynthesis, respiration, membrane stability and protein metabolism (Georgieva 1999). A major mechanism of injury is by the generation of reactive oxygen species such as superoxides, hydrogen peroxide and hydroxyl radicals which damage cellular components (Noctor and Foyer 1998; Liu and Huang 2000; Breusegem et al. 2001).

On the other hand, plant species growing in tropical and sub-tropical regions show characteristic damage symptoms of both roots and shoots exposed to chilling temperatures (Raison and Lyons, 1986; Zhang *et al.*, 1995; Queiroz *et al.*, 1998). Chilling injury is associated with changes in membrane properties, such as solute leakage, reduced transport across the plasma membrane malfunction of the mitochondrial respiration and inhibition of photosynthetic activity (Lyons, 1973; Lyons *et al.*,1979), and induction of active oxygen species (Omran, 1980; Prasad *et al.*,1994; Radyuk *et al.*, 2009). In genetically engineered tobacco plants, chilling sensitivity has been shown to be correlated with the extent of fatty acid unsaturation of the glycerol lipids of fatty acid unsaturation of the glycerol lipids of plastid membranes (Murata *et al.*, 1992; Kodarna *et al.*, 1994).

During the time of temperature stress (both elevated and chilling) reactive oxygen species (ROS) level can increase dramatically which can result in significant damage to cell structure. Prolonged accumulation of ROS is detrimental and can cause inactivation of enzymes, lipid peroxidation, protein degradation and damage to DNA (Asada, 1999). Controlling ROS production might therefore be a promising avenue of genetic engineering to enhance the tolerance of plants to temperature stress and a combination of temperature stress and high light (Allen, 1995). The extent of oxidative stress in a cell is determined by the amount of superoxide, hydrogen peroxide and hydroxyl radicals. Hydrogen peroxide, though toxic at higher concentrations, also plays significant role as signaling molecules in various functions like guard cell opening, photoprotection, pathogenesis and development (Desikan *et al.*, 2004, Miller *et al.*,2007).

In order to limit oxidative damage under stress condition plants have developed a series of enzymatic and non-enzymatic detoxification systems that break down the highly toxic reactive oxygen species (ROS) to less reactive molecules (Sairam and Tyagi 2004). Antioxidant enzymes such as superoxide dismutase, catalase, peroxidase, ascorbate peroxidase and glutathione reductase function in detoxification of superoxide and H_2O_2 (Mittler 2002). Protective roles of the antioxidant enzymes in temperature stress have been previously reported for a number of plants (Almeselmani et al. 2006; Babu and Devraj 2008). The balance of superoxide dismutase (SOD), ascorbate peroxidase (APX) and catalase (CAT) activities will be crucial for suppressing toxic ROS level in a cell. Changing the balance of scavenging enzymes will induce compensatory mechanisms (Chakraborty 2005). Antioxidant metabolites like glutathione, ascorbic acid, tocopherol and carotenoids also protect plants against oxidative stress (Sairam et al 2000). It has also been reported that increase in temperature leads to ion leakage and this could be used as an index for screening genotypes against heat stress (Deshmukh *et al* 1991).

A promising area for increasing resistance of crops to thermal stress is by the use of chemical treatments like salicylic acid, abscisic acid and calcium chloride (Larkindale and Knight 2002; He *et al.* 2005; Chakraborty and Tongden 2005). Acquisition of thermotolerance is likely to be of particular importance to plants that experience daily temperature fluctuations and are unable to escape to more favourable environments.

The present investigation was undertaken to determine the effect of high temperatures and low temperatures on antioxidative enzymes, antioxidants, lipid peroxidation and membrane stability on different varieties of lentil (*Lens culinaris)* and soybean (*Glycine max*) respectively, as well as to identify the most tolerant varieties and markers for tolerance and susceptibility. Besides, amelioration of high temperature stress by pre-treatment with some chemicals has also been attempted.