SYNOPSIS

Plants have evolved strategies to perceive mechanical stress in order to sense changes in their environment. In nature, plants can perceive mechanical perturbations during raining, blowing of wind, grazing by herbivore animals, touching of neighbouring plants, snowing and even landing of insects (Jaffe and Brio 1979, Braam 2005, Chehab et al 2009, Li and Gong 2011). At cellular level, the mechanical stress exerted on cell-wall due to turgor pressure, wounding and damage to cell wall layers can also be sensed by a plant cell (Heil et al 2009). Prolonged mechanical stress result in several morphological, physiological, biochemical and anatomical adaptations some of which are common and a few are unique to plant species. Morphological changes observed in response to mechanical stress is also known as thigmomorphogenesis (Jaffe 1973). Regular mechanical stress leads common adaptations like stunted shoot and root growth and altered flowering period (Braam 2005, Chehab 2009). At tissue levels mechanical stress leads to increased compactness of cells, reduced cell size and enhanced lignin deposition (Porter et al 2009, Meng et al 2006). Biochemical analysis after touch treatment shows alternations in chlorophyll ratio, levels of plant hormones, change in intracellular calcium levels and ROS production (Biddington 1986, Allen et al 1999, Slesak 2008). Studies indicate that these anatomical and morphological adaptations help the plant to withstand and cope with mechanical stress. In Arabidopsis, transcriptome analysis performed after touch treatment shows increased expression of genes which code for calcium binding proteins, defense response genes and Jasmonic acid/ ethylene responsive genes (Lee et al 2005, Pillai, S. E., & Patlavath, R 2015). This indicates that plants recognise touch as threat and raise responses which alerts the plant for herbivore attack. In few plants, adaptation to mechanical stress provides tolerance to biotic and abiotic stress as well (Biddington 1986, Chehab 2009).

Current knowledge of morphological adaptations and gene expression analysis is being applied in agriculture and pest management. Mechanical stress induced morphological changes has been studied in many crop plants namely *Cucurbita*, *Pisum*, wheat, lettuce, cauliflower, *Populus*, celery, *Carica papaya* and *Nicotiana* (Jaffe 1973, Biddington and Dearman 1985, Pruyn et al 2000, Porter et al 2009). Thigmomorphogenesis is being studied in economically important plants with an aim to identify novel traits. For example, ornamental plants are maintained short for aesthetic value by giving regular mechanical stimuli (Börnke, F., & Rocksch, T. 2018). Regularly touched papaya plants exhibited higher lignin deposition and reduced anthocyanin production in the petiole (Porter et al 2009). In tobacco, touching of stem increased vegetation (Anten 2005). As mechanical stress induces expression of defense response genes, touch stimuli is also being studied for development of environment friendly techniques for pest/ disease control in plants (Catherine Coutand, 2020). Regular touching enhanced resistance against necrotrophic fungi, *Botrytis cineria* in Arabidopsis and reduced feeding by cabbage looper pest, *Trichoplusia ni* on lettuce crop (Chehab et al 2012). Interestingly, different plant species display different adaptations in response to mechanical stimuli, some of which are unique to particular plant species. In present study, we have made first attempt to identify morphological, anatomical, biochemical and physiological adaptations of a dicot crop *Cajanus cajan* and a monocot crop *Oryza sativa* to regular mechanical stress in the form of touch.

Cytosolic calcium (Ca^{2+}) levels is altered upon mechanical perturbations like touch and wounding in plants (Cosgrove and Hedrich 1991). Ca^{2+} mediated intracellular communication is generally facilitated by calcium sensors; calmodulin (CaM) and calmodulin like-molecules (CML). Gene expression studies in Arabidopsis shows that expression of many CaM and CML molecules is induced within 30 min of touch stimulation (Braam and Davis 1990; Lee et al 2005). In Arabidopsis, Braam and co-workers have extensively worked on few of the touch induced CaM and CML also as known as TCH genes (Braam and Davis 1990). Thus by studying expression of TCH genes in *C. cajan* and *O. sativa* we can hypothesis that a similar mechanism of touch perception is present in these two crops.

MAIN OBJECTIVES OF THE RESEARCH WORK

- Study of effect of regular touch treatment on morphology, anatomy and physiology of dicot crop *Cajanus cajan*.
- Identification of TCH gene orthologues in *C. cajan* using bioinformatics and studying their gene expression.
- Study of effect of regular touch treatment on morphology, anatomy and physiology of Monocot crop *Oryza sativa*.
- Identification of TCH gene orthologues in *O. sativa* using bioinformatics and studying their gene expression.