CHAPTER I
INTRODUCTION

Drought is one of the abiotic stresses that can endanger rice growth and yield (Ali and Komatsu, 2006). The understanding of plant acclimation mechanism plays important role to improve plant drought tolerance. Plants respond to drought stress at the morphological, physiological, biochemical and molecular levels. Cells regulate their abundance and activity of proteins to cope with environmental stimuli. The changes of proteome can provide snapshot of cells in the action of these responses (Twyman, 2004).

There have been many reports on proteomic analysis of drought stress responsive proteins in rice. Ali and Komatsu (2006) have investigated drought-responsive proteins in two rice cultivars, Nipponbare and drought tolerant cultivar, Zhonghua 8, using proteomics analysis. Photosystem II oxygen evolving complex protein, oxygen evolving enhancer protein 2, actin depolymerizing factor and light harvesting complex chain II were up-regulated in Zhanghua 8. Ji et al. (2012) investigated drought-responsive proteins in two rice genotypes with contrast drought tolerance. Down-regulation of ATP synthase, orthophosphate dikinase, glycine dehydrogenase, glycine hydroxymethyltransferase and ribulose bisphosphate carboxylase were found in Zhenshan97B, a drought susceptible rice cultivar, under drought stress. In IRAT109, a drought tolerant rice cultivar, transketolase and Rubisco were down-regulated whereas Rubisco activase, peptidyl-prolyl cis-trans isomerase, chloroplastic superoxide dismutase and dehydroascorbate reductase were up-regulated under drought condition.

Chitosan is a biopolymer produced from deacetylation of chitin. It can be applied in agriculture as elicitor of plant defense mechanism (Agrawal et al., 2002; Povero et al., 2011), plant growth stimulator (Dzung et al., 2011; Limpanavech et al., 2008) and can prolong shelf life of post-harvest products (Harish Prashanth and Tharanathan, 2007). Moreover, chitosan could improve drought tolerance. It was found that chitosan could reduce transpiration by inducing ABA-dependent stomatal closure via hydrogen peroxide mediated process (Bittelli et al., 2001; Iriti et al., 2009; Lee et al., 1999). Srivastava et al. (2009) revealed that nitric oxide acted downstream of the ROS production. MKK9 and MKK12 were shown to involve in chitosan-induced stomatal closure by function downstream of ROS production, cytosolic alkalization and $[Ca^{2+}]_{cyt}$ oscillation (Salam et al., 2012). Foliar application of chitosan could improve water use efficiency in pepper plant (Bittelli et al., 2001). Boonlertnirun et al.

(2007) showed that 'Suphanburi 1' rice treated with chitosan prior to drought stress led to the higher yield and yield component, showed good recovery and reduced percentage of damaged leaves. Moreover, application of chitosan prior to drought stress could increase superoxide dismutase and catalase activities and membrane stability in apple seedlings (Yang et al., 2009). Chitosan increased accumulation of osmolyte such as proline, glycine betaine and soluble carbohydrate, osmotic adjustment and sustained osmotic potential during water stress. This improvement led to the increase in leaf area and yield component in cowpea under drought stress (Farouk and Abdul Qados, 2013).

According to Pongprayoon et al. (2013), LPT123 rice is more responsive to chitosan during drought stress than its drought resistant mutant line, LPT123-TC171. Application of 80% deacetylated oligomeric chitosan (O80) at a concentration of 40 mg/L three times by seed soaking and foliar spraying prior to drought stress could enhance shoot growth in LPT123 rice under drought stress whereas it had no positive effect in LPT123-TC171 rice. The aims of this study are to compare chitosan-induced protein patterns in LPT123 and LPT123-TC171 rice during drought stress by proteomic approach to display different proteins and protein profiles and to analyze expression of a chitosan-responsive gene during stress at transcriptional level. These findings may contribute to understanding the mechanisms of chitosan-induced drought tolerance in rice.