ID: 352

Genome Wide Identification of NPR-1 like Gene Family in *Theobroma Cacao* (Cacao) in Response to Biotic Stress

Muhammad Umar Rasheed, Aiman Malik, Muhammad Zeshan Haider, Adnan Sami, Muhammad Ashfaq, Muhammad Arshad Javed

Department of Plant Breeding and Genetics, University of the Punjab, P.O BOX. 54590, Lahore, Pakistan

Abstract

Cacao (Theobroma cacao), the source of chocolate, faces critical production challenges due to the harmful Cacao swollen shoot virus (CSSV). This virus causes substantial yield losses, threatening the global chocolate supply chain. Salicylic acid (SA) is a crucial plant defense signal molecule that triggers immune responses via the NPR1 protein. Upon SA activation, the cellular environment changes, leading to the reduction of disulfide bonds within the NPR1 complex. This releases NPR1 monomers, allowing them to activate defense genes in the nucleus. This study employed in-silico methods to identify and characterize NPR-1 like genes within the cocoa (Theobroma cacao) genome. Using computational methods, three NPR1-like genes (*TcNPR1*, *TcNPR2*, and *TcNPR3*) are discovered. Phylogenetic analysis revealed that TcNPR1 and TcNPR2 cluster with known SA signaling genes in Arabidopsis, suggesting they may play similar roles in cacao's defense pathways. Interestingly, TcNPR3 formed a distinct evolutionary group, hinting at possible unique functions. Further analysis revealed the presence of conserved motifs essential TGACG motif for NPR1 function in all TcNPRs proteins. Transcriptomic analysis showed increased expression of TcNPR2 in response to Phytophthora megakarya infection, highlighting a potential role in defense activation. The identification of miRNAs targeting TcNPR3 raises the possibility of CSSV suppressing cacao's immune response by downregulating this critical gene. Our study helped to elucidate the understanding of NPR1-like genes in cacao and provides crucial insights into their potential roles in defense against. These findings lay the foundation for developing strategies to enhance disease resistance in cacao, ensuring the sustainable production of this economically vital crop.

Keywords: *Cacao, Badnavirus, NPR1, Salicylic Acid, Disease Resistance*