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A REVIEW

Molecular basis of self-incompatibility and its utilization in crop improvement

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Abstract : Self-incompatibility, is a genetically controlled mechanism for rejection of own pollen. It has been a favourite topic for botanists and geneticists since Darwin who first discussed this phenomenon and suggested its central significance during the evolution of flowering plants. Different genetic and mechanistic systems of SI among different plant families suggest either multiple origins of SI or considerable evolutionary diversification. Within the last two decades, molecular and biochemical analyses which have significantly contributed to the elucidation of the complex series of interactions occurring at the pollen-stigma interface. Molecular analyses of self incompatibility systems have focused on identifying and characterizing the pollen and pistil components of the self-incompatible response as well as other proteins and events that lead to pollen rejection. In this review, an attempt has been made to provide a comprehensive insight for the molecular dissection of this important mechanism for its utilization in crop improvement.

Key Words : Self-incompatibility, S-allele, Pollen-stigma interaction, Molecular analysis, Gametophytic, Heteromorphic

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INTRODUCTION

Various bisexual flowering plants evade the harmful effects of inbreeding by employing genetically controlled self-incompatibility (SI) mechanisms to ensure out crossing (Charlesworth and Charlesworth, 1987). SI mechanisms make available the biochemical machinery essential for plants to recognize and discard their own pollen as well as non-self pollen with a genotype amply similar to obtain activation of the SI mechanism. SI plays an important role in determining the spatial and temporal distribution of genetic diversity in plant populations and is thought to influence patterns of lineage diversification in clades within which these mechanisms are utilized (Igic *et al*., 2008). About 96 per cent of flowering plants produce perfect flowers that contain both the male and female reproductive organs in close proximity; accordingly, they would have a strong affinity to self-fertilize if there were no mechanisms to prevent them from doing so. Because inbreeding can result in reduced fitness in the progeny, hermaphroditic plants have adopted a variety of reproductive strategies, including self-incompatibility (SI), by which inbreeding is prevented and outcrosses are promoted (de Nettancourt 2001). SI allows the pistil of a flower to distinguish between genetically related (self) and unrelated (non-self) pollen. This self/non-self recognition results in the inhibition of germination of self-pollen on the stigmatic surface or the inhibition of growth of self-pollen tubes in the style. Self-incompatibility thus, the most sophisticated and widespread in occurrence, has been known in flowering plants for over a century since Darwin's description in 1876 (Darwin, 1876). SI was defined by de Nettancourt (1977) as 'the inability of a fertile hermaphrodite seed plant to produce zygotes after self-pollination'. In other words SI is a prezygotic reproductive barrier by which incompatible pollen/pollen tubes are prevented from delivering the sperm cells to the ovary to affect double fertilization (Sims, 1993; Charlesworth *et al*., 2005). Incompatibility is widespread and present in species of Leguminosae, Solanaceae, Cruciferae, Compositae and

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