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A REVIEW

Self-incompatibility: a pollination control mechanism in plants

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SUMMARY

Mode of pollination is very important in plant breeding because it determines the genetic constitution, nature of gene action, ease in pollination control and stability of varieties after release. There are several mechanisms that promote cross pollination, among these self-incompatibility (SI) is of special significance as it is used in hybrid seed production. SI is defined as the prevention of fusion of fertile (functional) male and female gametes of the same plant (Gowers, 1989). SI is a system where self-recognition and rejection is the rule that prevents inbreeding depression. Bateman (1952) classified self-incompatibility based on the interaction between pollen grains and pistil as complementary and oppositional system. Lewis (1954) has classified SI into homomorphic and heteromorphic systems. Homomorphic SI is again subdivided into gametophytic (determined by the genotype of gametes) and sporophytic (determined by the genotype of the plant) systems. Molecular studies after 1980's revealed that at least two genes within S-locus control the SI, among these one unit function as male and the other as female determinant. In Brassicaceae family, the determinant gene encodes a pollen ligand and its stigmatic receptor kinase and their interaction induces incompatible signaling within the stigma papilla cells. In the Solanaceae, Rosaceae, and Scrophulariaceae, the female determinant is ribonuclease and F-box protein, suggesting the involvement of RNA degradation and protein degradation within the system. In the Papaveraceae, the female determinant induces Ca^{2+} dependent signaling network that ultimately results in the death of incompatible pollen (Takayama and Isogai, 2005). Genes controlling the SI is multiallelic in nature and number of alleles varies depending upon the crop. Number of alleles reported are five in *Theobroma cacao* (Knight and Rogers, 1953), 30 in *Brassica campestris* (Singh, 2012), 32 alleles in *Raphanussativus* (Karron *et al.*, 1989). SI is commercially exploited for the production hybrid seeds. Pusa Hybrid-2, Snow Queen and Snow King hybrids of cauliflower, BRH-5, H-44 of cabbage and CCRP8 to CCRP15 (Minimol *et al*., 2015a) of cocoa are some of the examples. Kucera *et al.* (2006) has compared the quality between SI and male sterility hybrids in cauliflower and it was found that SI hybrids are superior in their performance. Minimol *et al*. (2015b) emphasized the importance of polyclonal garden in cocoa for production of F_1 hybrid seeds by utilizing the self-incompatibility. Rego and Rego (2013) evaluated the efficiency of three methods of overcoming self-incompatibility in passion fruit and found fruit set of 16.67 and 10 per cent in bud and double pollination, respectively. The main limitations in exploiting SI is the maintenance of inbreds, however, it can be overcome by some temporary methods such as bud pollination, salt sprays and irradiation methods.

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