FUNCTIONAL ANALYSIS AND MAP-BASED CLONING OF NONFUNCTIONAL STAY-GREEN GENE IN RICE

Jae-Woong Yu, Jong-Seong Park, and Nam-Chon Paek
(ncpaek@plaza.snu.ac.kr)

Department of Plant Science, Seoul National University, Suwon 441-744, Korea

Introduction

Senescence is the final stage of growth and development in plants. Leaf yellowing due to chlorophyll degradation is widely used as a phenotypic marker of plant senescence, although a series of other biochemical and physiological changes are also involved (Noodén, 1988; Matile, 1992). Leaf senescence is induced by a number of environmental and developmental factors, and timing of leaf senescence is controlled by the genetic background rather than passive degenerative process (Buchanan-Wollaston, 1997; Wingler et al., 1998). Many senescence-related mutants have been found in crop plants that maintain leaf greenness after grain ripening stage, which are referred to as stay-green or non-yellowing (Thomas and Smart, 1993).

On the basis of the behavior, the stay-green phenotype was classified into five types (Thomas and Howarth, 2000). With type A stay-green, the initiation of senescence is much delayed, but then proceeds at the same rate as the wild type. Type B stay-green initiates senescence at the same time as the wild type, but leaf yellowing and decrease in photosynthetic rate are slower. The above two types are regarded as functional stay-green due to the prolonged photosynthetic activity during seed filling. On the other hand, type C stay-green retains chlorophylls almost indefinitely due to the malfunction of chlorophyll degradation mechanisms. However, as the physiological function reveals, senescence proceeds normally in plant tissues, so called `cosmetic' stay-green. Type D stay-green results in the leaf death by abrupt freezing or drying. Finally, type E stay-green accumulates high chlorophyll content but without increasing the photosynthesis. Thus, the functional stay-green (types A and B) retains both chlorophylls and photosynthetic competence in leaves during seed filling, while leaves of the nonfunctional stay-green (types C, D, and E) appear green but lack the photosynthetic competence.