Short Note

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Gene Stacking: An Alternative Strategy for Food and Nutritional Security

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Gene stacking refers to the combination of two or more (trans) genes of interest in the genome of the host plant, i.e. the created genetically modified organism (GMO) carries two or more different new traits. Since many important traits as well as complex metabolic pathways depend on interactions among number of genes, transgenic technology has been advancing towards transfer of multiple genes from the earlier single gene transfer.

Genetic engineering has progressed rapidly during last few years. In almost all cases reported to date, improved plant performance has been realized with the expression of a single foreign gene. However, there are many potential applications of plant genetic engineering, which involves the introduction and expression of multiple genes in plants. The transfer of such multiple gene(s) is either quite difficult or practically not possible to accomplish with help of conventional plant breeding. A number of approaches have been proposed to introduce multiple genes into plants. These includes sexual crossing between plants carrying separate transgene, sequential retransformation and co-transformation. Each approach has its merits and demerits. Multigene transfer (MGT) is a gene stacking approach to generate plants with more ambitious phenotypes (Shaista *et al*., 2009a). It allows researchers to achieve goals that were once thought to be impossible, such as the import of entire metabolic pathways, the expression of entire protein complexes, the development of transgenic crops simultaneously engineered to produce a wide spectrum of added-value compounds. It has been successfully utilized in improvement the crop plants worldwide for wide range of traits. Elite inbred of South African transgenic corn was developed in which the levels of 3 vitamins were increased specifically in the endosperm through the simultaneous modification of 3 separate metabolic pathways. The transgenic kernels contained 169-fold the normal amount of carotene, 6-fold the normal amount of ascorbate, and double the normal amount of folate. Similarly, metabolic engineering of the canola, soybean, potato and rice have been successfully executed by multigene transfer technology for improvement of different quality traits worldwide (Shaista et al., 2009b) whereas in rice, multiple insecticidal genes are stacked to confer broad resistance against a range of insect pests (Maqbool *et al.*, 2001). More importantly, genetically modified (GM) crops with three or more stacked genes already approved for commercial production (Halpin C, 2009).

Therefore, gene stacking is a better alternative choice under Indian context for improving nutritional quality along with higher productivity which otherwise quite difficult through conventional approaches due to their higher influence from environmental and interactions among the polygenes as well. However, as no single method is ideal, and individual method may suit some purpose more than others and looking in to biosafety aspects, these technologies more deserve to be far widely tested, compared, and further improved for broadening the knowledge base and to underpinning future routine multi-gene manipulation of the complex agriculture traits.

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