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Opinion

Cisgenesis a Step towards Development of New Efficient Crops

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Abstract

Genetic alterations based on the sexually congruent gene pool carries a good potential for giving rise to plants with environmental, economic and health benefits which can be essential for meeting need requirement for a more efficient and sustainable crop production. Transgenetic crop mixing of genetic materials between species that cannot hybridize by natural means is major burden for the common people. Cisgenesis is the transformation that was developed as substitute to transgenesis to meet this public concern. Cisgenesis rely on the fact that those plants are transformed whose genetic material is derived from species itself or from closely related ones which are capable of sexual hybridization. Moreover other foreign sequences such as selection genes and vector-backbone sequences must not be present. Some of the shortcomings of classical breeding have been overcome by Cisgenesis. It can be utilized as a fast and rapid tool for the transfer of genetic material between closely related plants.

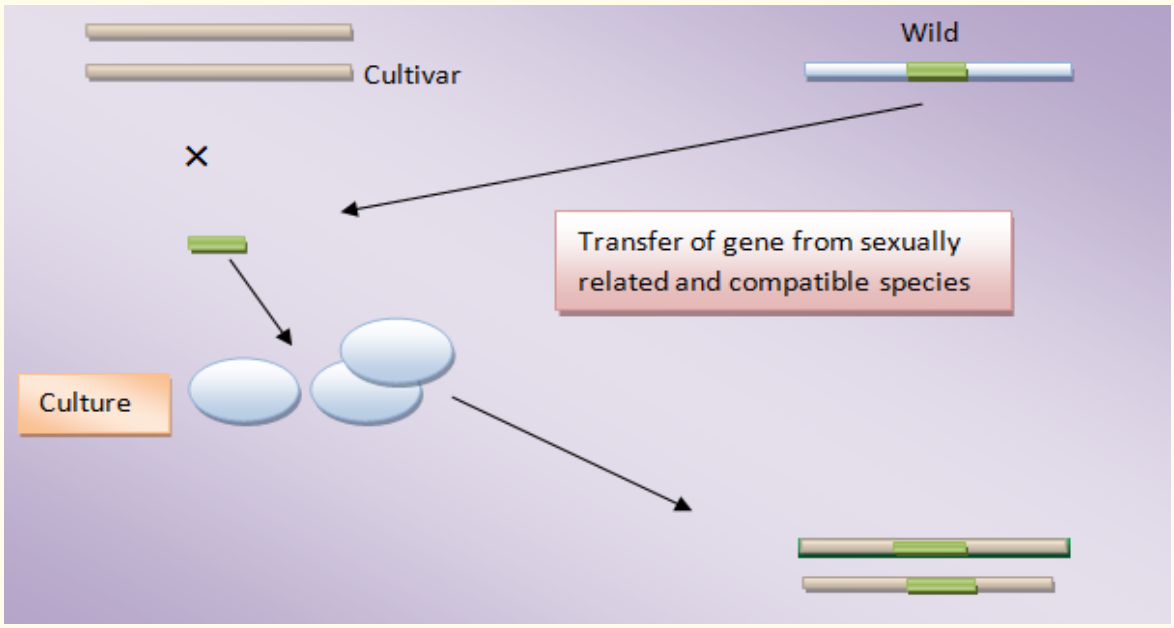
Keywords: *Transgenesis; Breeding; Gene Pool; Transformed; Propagation*

Introduction

Cisgenesis concept, the origin of the cisgene is extended to the gene pool of sexually compatible species and the cisgene is an identical copy of the endogenous gene including the promoter, introns and the terminator in the normal-sense orientation. Furthermore, when using *Agrobacterium*-mediated transformation, T-DNA border sequences can be used. It is evident that cisgenesis carry some limitations as compared to transgenesis because only traits in the sexually compatible gene pool can be combined and transferred into the crop Fig1. Furthermore, the isolation of genomic clones including the endogenous promoters and terminators and the subsequent development of marker- and vector-backbone-free plants requires additional expertise and time. The cisgenic concepts can also overcome limitations of classical breeding when it comes to improving traits with limited natural allelic variation within the sexually compatible gene pool. Higher expression level of a trait can be obtained by re-introducing the gene of the trait with its own promoter and terminator (cisgenesis).

Scab resistant apple

Most of the present-day commercial apple cultivars are susceptible to scab which is the most destructive fungal disease in commercial apple [1]. The disease is caused by the ascomycete *Venturia inaequalis.* The most commonly used resistance in conventional breeding of apple is the *Vf* locus from the wild apple *Malus floribunda* 821 [2]. Although this wild apple resistance has been transferred into different apple varieties through classical breeding, the procedure is extremely long and is associated with undesirable linkage drag. The *Vf* locus consists of a gene cluster of four paralogues but only one (*HcrVf2*) provides resistance against avirulent isolates of *V. inaequalis* [1]. Recently, a cisgenic apple with resistance to scab was developed through the transfer of the *HcrVf2* genomic clone including its own promoter and terminator into apple cv Gala [3].



Figure

What are all Pre requisites of Cisgenic plant?
Sequence information of plant
Sequence information of plant
Sequence information of plant
The isolation and characterization of gene of interest from crossable relatives
Transformation technique
Marker free transformation
Vectors development

Table 1

Intragenic/cisgenic crops developed or currently under development				
	Intra-/Cis-genesis	**Type**	**Gene**	**Trait**
	Crops with commercially widespread clones			
A	Potato (Intra)	Silencing	*GBSS**	High amylopectin
B	Potato (Intra)	Silencing	Ppo	Preventing black spot bruise
C	Potato (Infra)	Silencing	*Ppo, R1, PhL*	Limiting degradation of starch. Limiting acrylamide formation
D	Potato (Infra)	Silencing	*StAs1, StAS2*	Limiting acrylamide formation
E	Potato (Infra)	Silencing	*StAs1*	Limiting acrylamide formation
F	Potato (Cis)	Genes from related species	*R-genes*	Late blight resistance
G	Apple (Cis)	Gene from related species	*HcrVf2*	Scab resistance
H	Strawberry (Intra)	Overexpression	*PG1P*	Gray mould resistance

Table 2

Conclusion

Developments regarding the propagation and commercialization of cisgenic crops will solely depend on willingness to apply less iron fisted regulations to these crops worldwide. A less extensive regulation of cisgenic crops will reduce the costs for approval that would be very helpful to small-sized breeding and seed companies. This would provide breeders with an additional tool for the development and crop improvement and thus increase the number of cisgenic crops developed.

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