Genetic Engineering of Grapevine Cultivars and Rootstocks for Drought and Salinity Tolerance

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Introduction

Drought and salinity are major factors limiting grapevine production in semiarid regions of the United States. Grapevine genetic improvement for abiotic stress tolerance is paramount for the viticulture (study of grapes and their culture) industry worldwide.

Improved grape cultivars and rootstocks are traditionally developed by conventional breeding. The genetically diverse nature of the grapevines limits the number of traits that can be inserted into cultivars without disrupting existing fruit and wine characteristics. Additionally, seedling vines obtained by breeding take between 5–7 years for flowering and fruiting, which makes screening of new selections time consuming.

Genetic engineering offers a potential alternative to improve stress tolerance of elite cultivars without changing existing desirable characteristics. Such cultivars would be suitable for production in semiarid regions of the United States, including Wyoming.

Objectives

The goal of this study was to introduce traits conferring drought and salinity tolerance in elite grape cultivars using genetic engineering technology.

Materials and Methods

The experiments are being carried out at the Sheridan Research and Extension Center (ShREC). Leaves of grapevine cultivars ‘Bronx Seedless’, ‘Himrod’, ‘Interlaken’, and Vitis vinifera ‘Thompson Seedless’ were used to establish plant tissue cultures.

Genes that confer drought and salinity were used in genetic engineering studies. The gene sequences were optimized and transferred to grape tissue cultures by infecting them with a bacterial vector (Agrobacterium tumefaciens). This bacteria causes crown gall disease in grapes under natural conditions but is modified in the laboratory to act as a vector for gene transfer.

Following infection and gene transfer, plant tissue cultures were treated with antibiotics to eliminate remaining bacterial cells and then grown on tissue culture medium for multiplying transgenic cells and, ultimately,
producing transgenic plants that confer drought and salinity tolerance.

Results and Discussion

A wide variation in the production of transgenic cells was observed in different cultivars. Tissue cultures exhibiting vigorous growth are currently being grown to produce plants. We will analyze transgenic plants using various molecular techniques prior to testing them in a greenhouse and the field. Transgenic plants may eventually provide improved agricultural resources adapted to climates and soils in Wyoming and surrounding regions.

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