Virus-resistant Transgenic Tomato: Current Status and Future Prospects

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Abstract

Virus-resistant transgenic plants form an essential constituent of crop protection measures. Tomato is an important vegetable crop grown throughout the world for its nutritional benefits and tomato-based processed food consumption. However, the production levels of tomato are threatened by many viral infections. In the absence of resistant tomato genotypes (where available genetic sources or resistance are scarce), development of transgenic resistance to pathogenic viruses is indispensable. The last couple of decades have witnessed substantial progress in incorporating virus resistance trait in tomato. This chapter provides overview of the strategies and successful instances of transgenic virus resistance with special emphasis on prominent viruses infecting tomato. Various approaches to incorporate virus resistance in tomato from antisense RNA expression, through various RNA interference (RNAi) based strategies and foray in to genome editing techniques are discussed. The significant achievements made in developing transgenic resistance to combat *Tomato leaf curl viruses*, ground nut bud necrosis virus and *Cucumber mosaic virus* are presented. Also, the utility of employing recently emerging genome editing tool in incorporating resistance to tomato viruses is also discussed.

Introduction

Tomato is one of the important vegetable crops having tremendous global popularity. Due to its delicious taste, rich in micronutrients and antioxidants, tomato is the most valuable crop grown around the world. The antioxidant potential of tomato owing to its lycopene content protects against oxidative damage to the cells and slows the process of ageing and provides protection against many stress related diseases. With a worldwide production of 17 million metric tonnes and occupying 72% of total value of fresh vegetable market, tomato crop has potential economic value. However, the cultivation and the production status of tomato are threatened due to many diverse species of infectious, pathogenic viruses. The number of described viral species that infect tomato crops amounts to 136, whereas this number is notably lower for other vegetable crops (Hanssen *et al.*, 2010). One of the reasons for more number of viral species affecting tomato is the sensitivity of tomato crop to members of the genus *Begomovirus*, which comprises a large variety of species. With a limited genetic resource for disease resistance, intensive breeding for improved production and emergence of viral variants, tomato cultivation faces serious threat across the globe. Changing climate conditions also contribute to a successful spread of the virus or its vector in the areas that were previously unfavourable, thus enhancing viral spread in different geographical regions.

Considering the most important viral diseases of tomato inflicting damage in the last two decades, and efforts of genetic engineering in developing transgenic crops are discussed in this chapter. Thus,