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Genetic modifications for disease resistance in crops

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Introduction

It is estimated that the global human population will rise from the current 7.7 billion to ~8.5 billion by 2030 and 9.7 billion by 2050. According to a UN Food and Agricultural Organization report (FAO 2018), over 821 million people are undernourished in the world; ~200 million of them are in India alone. Hence, eradication of hunger (zero hunger) is one of the Sustainable Development Goals that the UN has set to achieve by 2030. To achieve the goal of zero hunger, we need to increase food production against the background of resource and climate constraints that the developing world is facing. Around 20–30% of the world's food grain production is lost due to damages caused by plant diseases and pests (Savary *et al.* 2012, 2019). In India, the importance of plant diseases was realised in the first half of the 19th century. In 1937, Mitra reviewed crop losses due to pests and diseases, and found that different rusts of wheat caused as much as UK£40 million of losses worldwide, UK£4 million of it in India.[1] In 1942, brown spot of paddy caused by fungus was partially responsible for failure of the rice crop in Bengal, with 40–90% yield reduction leading to the starvation death of ~2 million people during the great Bengal famine of 1943. Plant diseases cause ~30–50% of total crop losses due to all kinds of biotic stresses. These crop losses are aggravated by climate change, intensive cropping, introduction of new pathogens and strains and change in their virulence status, facilitated with global trade.

Crop disease resistance: management practices

Management of crop diseases generally involves four main approaches: host plant resistance, chemical control, biological control and crop husbandry practices. Even though cultural practices such as managing the planting date, crop rotation and ecological engineering via multi-species cropping systems have yielded desired results in the management of diseases, at times these measures are inadequate or practically not feasible. Biological control has not yielded desired results in many destructive and rapidly spreading crop diseases. Over-dependence on pesticides has caused pollution and ecological imbalance in the agroecosystem. However, growing awareness about environmental pollution, pesticide residues in food products and the evolution of resistance in plant pathogens has led to the implementation of