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The Significance of PRSV in Papaya and Transgenic Disease Management

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Abstract

Papaya Ring Spot Virus (PRSV) still a major constraint to papaya production all around the globe, managing this deadly disease remains the most difficult task. Using advanced transgene technologies, various PRSV resistance verities are developed which are proven as successful strategies for controlling the disease. Hence transgenic disease management is a top research priority for the papaya production to meet the goal of global food safety and security. This article summarizes the importance of PRSV, its symptoms, biology and transmission of virus and also highlighted the importance of transgenic varieties in disease management.

Keywords: PRSV, Transgenic papaya, Potyvirus

Introduction

Papaya (*Carica papaya*) is one of the important fruits belonging to the family Caricaceae with a chromosome number of 2n=2x=18. The fruit is originated from Central America and now growing in all tropical, subtropical regions of the world (Silva *et al.*, 2007). Papaya Ring Spot Virus (PRSV) is the most economically significant virus infecting papaya followed by Papaya Leaf Curl Virus (PLCV), Papaya meleira virus (PMeV), Papaya mosaic virus (PapMV), Papaya lethal yellowing virus (PLYV)and numerous other viruses are known to infect. PRSV was first reported in the Hawaii islands of United States in the 1940s (Jensen 1949).Many locations have restricted papaya production due to the prevalence of the papaya ringspot virus, which can ruin the economic value of whole plantations, severe postharvest losses from to this virusescan range from 30% to 60% of a single harvest.

Disease Symptoms

Papaya Ring Spot Virus (PRSV) is the causative agent of ring spot disease in papaya. The disease characterized by yellowing, severe moaic, mottling, blister-like regions, and leaf distortion. Oily or water-soaked spots and streaks appear on the trunk and petioles, the fruit

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exhibit bumps and the classic 'ringspots. Severe isolates also been shown to cause tissue necrosis.

Biology and Transmission

PRSV belongs to the genus Potyvirus and the family Potyviridae.The virus is a non-enveloped, flexuous rod-shaped particle with a length of 760 to 800 nm and a diameter of 12 nm. It has around 2000 copies of coat protein (CP), which encapsulates a single stranded, positive-sense RNA (+ ssRNA). Its genome is around 10 kb long, with a 5′ terminal-linked protein (VPg) and a 3′ poly-A tail. Because of its positive-sense RNA genome, it can function as a messenger RNA and code for proteins.It transmits from plant to plant mechanically by pruning and biologically through a variousspecies of aphids such as *Myzuspersicae.*

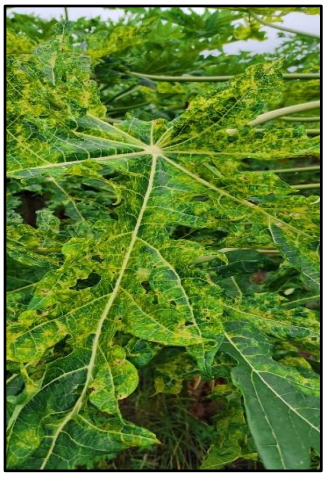

Fig.1 Ring spots on fruits **Leaf Distortion** **Severe mosaic**

Transgenic Management

Due to the sexual incompatibility between wild species and cultivated papaya, the development of PRSV employing standard breeding techniques has been challenging. 'Cross protection' is a form of disease management that protects mild viral strains from the economic damage caused by severe virus strains, but it also needs additional agricultural skills and attention. Pure strains of mild virus were difficult to propagate because of technical difficulties and their scarcity renders this strategy ineffectual. The Pathogen Derived Resistance (PDR) idea is a novel strategy for managing PRSV,which was developed by Sansford and Johnston. This method is regulated by either by protein mediated or RNA

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mediated pathways. Through the deployment of coat protein (CP), RNA silencing, and replicase gene technologies, PRSV resistant transgenic papaya has been produced.

Fitch *et al.* developed first transgenic papaya having CP genes resistance to PRSV by adopting gene transfer strategy of premature zygotic embryos with a plasmid construction encoding the neomycin phosphotransferase II (*npt*II).Later, PRSV mediated by CP was extensively used. Cultivars such as Sunrise solo, Sunset solo, CV.F65 others were developed through this method by using either biolistic or *Agro bacterium* transformation method.

RNA interference (RNAi) mediated virus resistance was first discovered by Waterhouse et al. against Potato virus Y in transgenic tobacco plants. This method is used for generating disease resistance by blocking a specific gene or genes.PRSV is a RNA virus with a single open reading frame that is translated into a massive polyprotein that generates protein products.Proteinase (HcPro), a helper component, has been proven to be a highly efficient suppressor of RNA silencing.HcPro is acrucial component that must be considered for developing PRSV resistant papaya cultivars in India. Resistance developed by the deployment of replicase gene was initially demonstrated for the tobacco mosaic virus (TMV) in *Nicotiana tabacum.*Replicase genes (RP) imparted resistance to PRSV in transgenic papaya.(Khung*et al.*, 2009).Mutated Replicase genes (RP) showed higher resistance to PRSV in case of transgenic papaya.

Conclusion

PRSV is the greatest threat to papaya cultivation. Hence for controlling the disease through CP genes or RNA interference techniques, PRSV-resistant papaya cultivars were developed all around the world, However, the main obstacle to growing transgenic papaya is the loss of PRSV resistance. Research should be done to reduce this issue, despite the minimal gene flow of PRSV-transgenic papaya. The use of transgenic papaya that is resistant to PRSV is still in its initial phases only and is reliant on public acceptability of the technology as well as biosafety laws. According to most recent studies, the environment and human health both are safe from transgenic papaya that is PRSV resistant.

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