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Mycoviruses: An Introduction to Potential Biocontrol Agents

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Mycoviruses are prevalent in all major groups of plant pathogenic fungi. Most have dsRNA but other has ssDNA, ssRNA and dsDNA. They are transmitted in nature through hyphal anastomosis and heterokaryosis, and are disseminated by means of spores. Their natural host ranges are restricted to individuals within the same or closely related vegetative compatibility groups. Mycoviruses reduce the virulence of their fungal hosts. Such fungal-virus systems are precious for the development of novel biocontrol strategies.

Introduction

Mycoviruses are viruses that infect fungi. They are prevalent in fungi and, in most cases, are associated with latent infections of their hosts. Hollings (1962) first reported the presence of virus particles in diseased mushroom sporophores. Most mycoviruses have dsRNA but other has ssDNA, ssRNA and dsDNA. Generally spherical in shape, others are bacilliform, rod shaped and herpes like shape. Mycoviruses are typically grouped into several families, including *Totiviridae, Partitiviridae, Chrysoviridae, Hypoviridae* and *Nanoviridae*. They have been attractive because of their importance in the biological control of fungal plant diseases. The successful biological control of chestnut blight with hypovirulent strain has stimulated others to search for hypovirulence-associated mycoviruses in other plant fungal pathogens.

Taxonomy: Most mycoviruses have double-stranded RNA (dsRNA) genomes, but about 30% have positive sense, single-stranded RNA (+ssRNA) genomes. Recently a DNA mycovirus was found in *Sclerotinia sclerotiorum* conferring hypovirulence to its host. Generally spherical in shape, others are bacilliform, rod shaped and herpes like shape. Mycoviruses are typically grouped into several families, including *Totiviridae, Partitiviridae, Chrysoviridae, Hypoviridae,* and *Nanoviridae.*

Host range: Mycoviruses are widespread in fungi and are found in all four phyla of the true fungi: Chytridiomycota, Zygomycota, Ascomycota and Basidiomycota. They were believed to have a narrow host range, though they are not different from other viruses that infect other organisms and may have broad host ranges. Similarly, some mycoviruses might have a narrow host range.

Fungus-virus interaction: It can be grouped into three types.

- Symptomless or cryptic infection.
- Hypovirulence and reduced pathogenicity of fungus, Example: *Magnaporthe oryzae.*
- Beneficial interaction: Increased thermal tolerance, and increased competitive ability by producing a killer protein (*Ustilago maydis*).

Transmission: To date, no mycovirus vector has been identified. Mycoviruses have used highly efficient means for transmission and spread. They are transmitted in nature through hyphal anastomosis and heterokaryosis (lateral transmission), and are disseminated by means of spores.

Viruses infecting plant pathogenic fungi: The plant pathogenic fungi are also infected by viruses affecting their disease causing ability. Though the first mycovirus infecting a plant pathogenic fungus was isolated from *Magnaporthe oryzae*. The following are the main plant pathogenic fungus in which mycoviruses have been reported.

Table 1: List of viruses infecting plant pathogenic fungi

S. No.	Fungus	Disease	Virus	Genus
1	*Magnaporthe oryzae*	Rice blast	*MoV1 and MoV2*	*Totivirus*
2	*Rhizoctonia solani*	Sheath blight	*Rhizoctonia virus M2*	*Mitovirus*
3	*Sclerotinia sclerotiorum*	White mold	*SsDRV*	*Alphaflexivirus*
4	*Cryphonectria parasitica*	Chestnut blight	*CHV1*	*Hypovirus*
5	*Ophiostoma novo-ulmi*	Dutch Elm disease	*Ophiostoma mitovirus*	*Mitovirus*
6	*Diaporthe ambigua*	Canker on *Rosaceae*	*DaRV*	*Carmovirus*
7	*Fusarium graminearum*	Head blight	*Fusarium poae virus*	*Partitivirus*
8	*Botrytis cinerea*	Grey mold	*BVF* and *BVX*	*Mycoflexivirus*

Exploration of mycoviruses for the biological control of crop diseases: In the early 1950s, it was found that chestnut trees infected by *C. parasitica* were not killed, and the lesions on the stems healed with no outside influence. This finding resulted in the discovery of hypoviruses and the biological control of chestnut blight with hypovirulent strains. The successful biological control of chestnut blight with hypovirus-mediated hypovirulence has inspired to explore other mycoviruses to manage dreadful fungal diseases. However, successful biological control of fungal diseases depens on the natural spread of viruses and that the characteristics of triple interaction (hypovirus, fungal pathogen, and host) and environmental factors determined the success or failure.

Advantages of mycoviruses to control crop diseases: Using hypovirulence-associated mycoviruses have some advantages that control crop fungal diseases.

- Once hypovirulence-associated mycoviruses are transmitted to a virulent fungal strain, they rapidly inhibit lesion expansion since viruses aim to reach the growth region of the colonies for replication.
- The fitness of a hypovirulent strain on crop plants is not to be a problem. Since plants are densely covered by the hypovirulent strain via spraying, whether the strain produces spores or other propagation bodies on plants is immaterial because crops are harvested at the end of the growing season.
- Hypovirulent strains also share a similar niche with virulent strains, and so hypovirulent strains can grow well on hosts.

Conclusion

In view of the current drive to develop sustainable practices for agriculture, use of mycoviruses for biocontrol of plant pathogenic fungi represents an attractive approach. Mycoviruses possibly will contribute to sustainable agriculture as biological control agents. At present, because of the lack of appropriate disease control strategies, control of plant pathogenic fungi is a difficult task. Use of fungicides possess health hazards and the risks to the environment, this is often cost prohibitive. Mycoviruses have the potential to control fungal diseases of crops when associated with hypovirulence.

References

Anagnostakis SL. 1982. Biological control of chestnut blight. *Science.* **215:** 466-471.

Ghabrial SA and Suzuki N. 2009. Viruses of plant pathogenic fungi. *Annual Review of Phytopathology*. **47:** 353-384.

MacDonald WL and Fulbright DW. 1991. Biological control of chestnut blight: Use and limitations of transmissable hypovirulence. *Plant Disease.* **75**(7): 656-660.

Milgroom MG and Cortesi P. 2004. Biological control of chestnut blight with hypovirulence: a critical analysis. *Annual Review of Phytopathology*. **42:** 311–38.

Xie J and Jiang D. 2014. New insights into mycoviruses and exploration for the biological control of crop fungal diseases. *Annual Review of Phytopathology*. **52:** 45-68.