AGRIALLIS
Science for Agriculture and Allied Sector: A Monthly e Newsletter
Volume 2 – Issue 9
Online ISSN: 2582-368X
www.agriallis.com

BACTERIOPHAGE - A POTENTIAL BIO-CONTROL AGENT

Article Id: AL202098

R. Selastin Antony

Institute of Agriculture, Tamil Nadu Agricultural University, Kumulur, Trichy, India

Email: selastinr@gmail.com

Most of the plant pathogens are of fungal origin, even though bacterial plant pathogens are in minimum numbers, are responsible for severe economic losses in agriculture. Controlling of such bacterial diseases is generally challenging due to lack of efficient bactericides, increased pathogen variability, increasing population of the pathogen under favourable conditions, high transformation rates resulting in pesticide resistance development, high mutation rates also led to bacteria overcoming plant genetic resistance.

Need for Bacteriophage as Biocontrol Agent

From earlier days, antibiotics and copper compounds are the regular means for managing bacterial plant diseases. Due to the continual use of copper fungicides, copper resistant bacterial strains were formed and which reduced the control efficacy. Continuous copper use is responsible for environmental hazards due to build-up to toxic levels in soils. Antibiotics usage paved the way to resistant strains led to the loss of control of many pathogen systems. This initiated the accomplishment of eco-friendly alternatives, like plant activators and biocontrol agents.

Bacteriophages

Bacteriophage (phage) is a virus that infects and replicates within bacteria and archaea. Bacteriophages are among the most common and diverse entities in the biosphere. Bacteriophages are omnipresent, found wherever specific bacteria (host) exist. Bacteriophages infect and lyse host bacteria. Interest in the capability of phages to control bacterial growth has spread wings from medical applications into agriculture.

Volume 2 – Issue 9
Online ISSN: 2582-368X
www.agriallis.com

Bacteriophage for disease control

The use of phages for disease control is a rapidly mounting area of plant disease control with immense potential to replace most of the present chemical control measures. Bacteriophages can be used successfully in integrated disease management strategies. The relative ease of preparing phage treatments make them good candidates for extensive use in developing countries as well. However, the effectiveness of phages depends significantly on prevailing environmental factors as well as on the vulnerability of the pathogen as in many biological control agents. At most care is essential during development, production and application of phage treatments. Additionally, regular monitoring for the emergence of resistant bacterial strains is necessary.

Phage therapy

Bacteriophages were first reported in association with plant pathogenic bacteria in 1924 against "cabbage-rot" caused by *Xanthomonas campestris* pv. *campestris*. Subsequently, phages were effectively used to control potato tuber rot caused by *Erwinia carotovora* subsp. *atroseptica* and Stewart's wilt of corn, caused by *Pantoea stewartii*. Thereafter many bacterial diseases of crop plants were biologically controlled by phage therapy (Table 1)

Table 1. Successful usage of phage therapy against different plant disease

Host	**Disease**	**Pathogen**
Cabbage	Black rot	*Xanthomonas campestris pv. campestris*
Citrus	Citrus canker	*Xanthomonas citri subsp. citri*
Citrus	Citrus bacterial spot	*Xanthomonas fuscans* subsp. *citrumelonis*
Mungbean	Bacterial leaf spot	*Xanthomonas axonopodis pv. Vignaeradiatae*
Mushroom	Bacterial blotch	*Pseudomonas tolaasii*
Onion	*Xanthomonas* leaf blight	*Xanthomonas axonopodis pv. allii*
Pepper	Bacterial spot	*Xanthomonas campestris pv. vesicatoria*
Pomegranate	Fireblight	*Erwinia amylovora*
Potato	Potato scab	*Streptomyces scabies* [
Tomato	Bacterial spot	*Xanthomonas campestris pv. vesicatoria*
Tomato	Crown gall	*Agrobacterium tumefaciens*
Tomato, potato, brinjal	Bacterial wilt	*Ralstonia solanacearum*
Tomato, potato	Soft rot	*Erwinia amylovora*

Volume 2 – Issue 9
Online ISSN: 2582-368X
www.agriallis.com

Advantage of Phage therapy

- **Less chance for host to regain viability**: Once infected by an obligatory lytic phage, bacteria will not regain their viability.
- **Self-sustenance**: Phages are self- sustainable, self- replicating and self- limiting. Bacteriophage lives and replicate as long as the host bacterium is present in the environment and degrade quickly in the absence of its host.
- **Host specificity**: Phages are host specific and do not harm other beneficial bacteria or eukaryotes.
- **Less chance for inducing resistance**: Phage resistance occurs in small population size as they have a very narrow host range. Mutations of the bacteria leading to resistance to the phages frequently result in loosing of virulence.

Challenges in Phage therapy

- **Narrow host range:** phages host range is very narrow. Cannot infect different pathogenic bacterial species or even races
- **Skill needs for production:** Continuous study and improvisation of the phage formulations are needed from time to time.
- **Horizontal gene transfer:** The temperate phages can induce susceptible bacteria to a virulent one by horizontal gene transfer (HGT).
- **Environmental dependency**: Highly depend on the environmental condition for infection and proliferation

Conclusion

Continuous studies on improvisation of phage therapy, phage formulation development, method of application and managing a favorable environmental condition for phage activity may result in commercialization of phage therapy for controlling bacterial plant diseases in the near future.

Volume 2 – Issue 9
Online ISSN: 2582-368X
www.agriallis.com

References

Barua P. and Nath P D., (2018). Bacteriophages: A Potential Next Generation Biocontrol Tool for Plant Disease Management. *International Journal of Current Microbiology and Applied Sciences* . 7(09).

Balogh B., Jones J B., Iriarte F B. and Momol M T., (2010). Phage Therapy for Plant Disease Control. *Current Pharmaceutical Biotechnology*. 11: 48-57.

Jones J B., Vallad G E., Iriarte F B., Obradović A., Wernsing M H., Jackson L E., Balogh B., Hong J C. and Momol M T.,(2012). Considerations for using bacteriophages for plant disease control. *Bacteriophage*. 2(4): 208–214.