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Perspective

Applications of Bacteriophages as Bio-Control Agents to Combat Phytopathogens

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DESCRIPTION

As the global human population is expanding, the pressure to maximize food production persists. Phytopathogens, or bacterial infections that affect essential agricultural plants, can stunt plant growth and thus lower crop yields. Currently, copper sprays and the use of antibiotics are two management strategies that can be used to control phytopathogens. Alternative control agents must be created, nevertheless, due to the advent of resistant bacteria and the need to limit use of hazardous goods that build up in the environment.

Using particular bacteriophages (phages), viruses that only destroy bacteria, as a more focused method is an appealing choice. Phages that attack the phytopathogen are often isolated and characterized to see if they possess the characteristics needed for biocontrol. The phages must also be properly formulated and delivered to the damaged plants in order for them to survive in the environment and not harm the plant or target helpful bacteria. Phages have been effectively used in numerous experiments and on a commercial level after being isolated for various phytopathogens.

Along with this population growth, the world is also dealing with a shrinking agricultural land base and a warming planet. It is clear that more food must be produced in order to feed the world's expanding population, and less land and water are available. Plant diseases, which are influenced by evolving agricultural techniques and increased international trade, pose a serious danger to the production of food.

Recent examples of current events include citrus greening of oranges brought on by psyllids that spread *Candidatus Liberibacter* bacteria and canker of kiwifruit brought on by *Pseudomonas syringae* pv. *actinidiae* bacteria. Citrus greening, which was initially discovered in Florida in 2005, has increased the cost of orange production for producers there. 40% of the orchards in New Zealand have been infected with *Pseudomonas syringae* pv. *actinidiae*, which has caused a considerable economic damage to the industry.

To reduce the effect of bacterial plant diseases on the volume, quality, and economics of food production, a range of strategies are needed. In order to halt the spread of the virus from one location to another, conventional control measures include the development of operating procedures to stop additional infections, the removal of affected plant tissue, and proper disposal. Chemicals like insecticides, medications to control insect vectors, antibiotics (such tetracycline and streptomycin), copper, and other substances are some more ways to control phytopathogens. Since the 1950s, antibiotics like streptomycin have been employed, while copper has been used for over 100 years.

Streptomycin has been used for controlling infections, especially *Pseudomonas syringae pathovars*, for a long time, and resistance has frequently been noted after treatment. The transmission of antibiotic resistance genes to other bacteria whether environmental pathogens or nonpathogenic bacteria is another issue. *Xanthomonas* and *Pseudomonas* species, as well as other plant diseases, have been shown to have copper resistance. Copper sprays can cause dangerous amounts in the environment if they are used frequently. Therefore, it is advantageous to replace or incorporate less hazardous biological control approaches with chemical ways of control.

The use of bacteriophages (phages) as Bio-Control Agents (BCAs) to combat phytopathogens is becoming more and more popular. Phages are viruses that only affect bacteria and don't harm plants or animals in any way. A virulent phage's infection of a bacterial host usually leads in rapid viral multiplication, bacterial lysis, and the release of a large number of offspring phages. These phages can then spread to nearby bacteria and infect them. As a result, if target pathogens are contacted, the phage population will increase, and the therapy will effectively be multiplied in response to the bacterial infection.

Applictaions

The economic success of phage control of phytopathogens depends on a number of essential elements, including safety,

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efficacy, intellectual property, and a market. Phages are common and can be ingested along with food and water without causing any harm, thus their safety as BCAs is not a concern. The FDA has approved the use of phages to control *Listeria monocytogenes* in food and has given them the GRAS (Generally Recognized as Safe) designation. Interestingly, LISTEX (Micreos Food Safety) is regarded as organic in the EU and the USA, indicating that organic producers may represent a lucrative market for phage biocontrol products. Additionally, in Russia and Georgia, phages are utilized to treat bacterial illnesses in people.

Clinical trials have evaluated the safety of phages for treating burn victims as well as their efficacy in treating ear infections. These rigorously monitored medical studies show that phage therapy is safe and effective; demonstrating that phage management of phytopathogens won't result in negative health issues. It has been discussed elsewhere and in other articles in this special issue that phages are being developed as BCAs for the control of human diseases in animals and on food goods.

Intellectual property rights and patent protection are crucial aspects in phage BCA commercialization. Although phage therapy has been a notion for more than 90 years, numerous businesses have gained patents and built up commercial platforms.

Recent research on this has been done in-depth. In the agriculture industry, Omnilytics has created AgriPhage, a line of phage products, to treat tomato and pepper bacterial spots caused by *Xanthomonas campestris* pv. *vesicatoria* and tomato bacterial spots caused by *Pseudomonas syringae* pv. *tomato*.

Future developments are needed in the field of plant pathogen phage control, which is the least studied application of phage control and benefits from less regulatory and safety barriers.