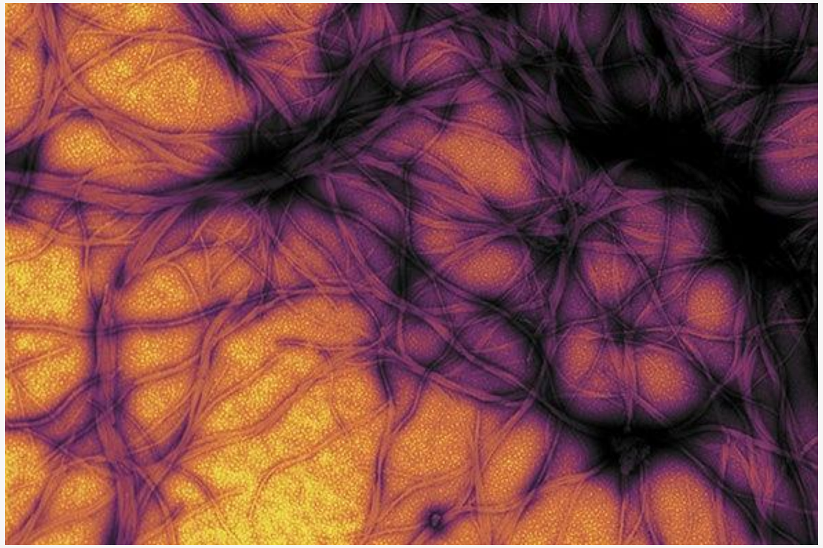
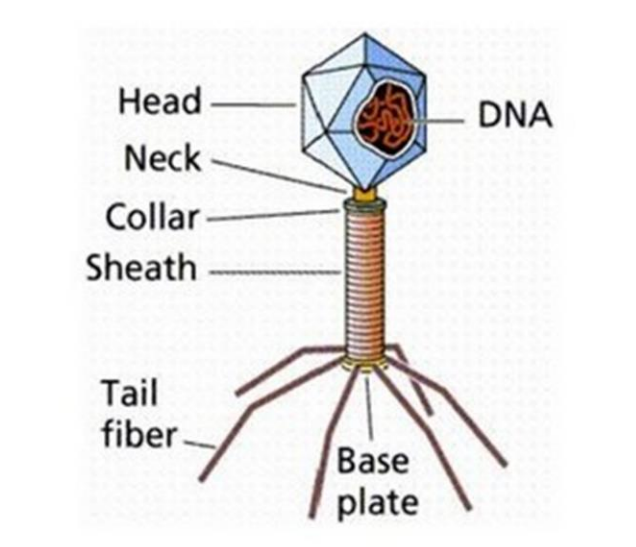
Effect of Bacteriophage on Agricultural soil



Bacteriophage

- A bacteriophage is a type of virus that infects bacteria. In fact, the word "bacteriophage" literally means "bacteria eater," because bacteriophages destroy their host cells.

- All bacteriophages are composed of a nucleic acid molecule that is surrounded by a protein structure.



- A bacteriophage attaches itself to a susceptible bacterium and infects the host cell.
- Following infection, the bacteriophage hijacks the bacterium's cellular machinery to prevent it from producing bacterial components and instead forces the cell to produce viral components.
- Eventually, new bacteriophages assemble and burst out of the bacterium in a process called lysis.
- Bacteriophages occasionally remove a portion of their host cells' bacterial DNA during the infection process and then transfer this DNA into the genome of new host cells. This process is known as transduction.

Soil Virus

- Viral abundance in soils can range from below detection limits in hot deserts to over 1 billion per gram in wetlands.
- Abundance appears to be strongly influenced by water availability and temperature, but a lack of informational standards creates difficulties for cross-study analysis.
- Soil viral diversity is severely underestimated and under sampled, although current measures of viral richness are higher for soils than for aquatic ecosystems.

Soil Virus

- Both morphometric and metagenomic analyses have raised questions about the prevalence of non-tailed, ssDNA viruses in soils.
- Soil is complex and critically important to terrestrial biodiversity and human civilization, but impacts of viral activities on soil ecosystem services are poorly understood.
- While information from aquatic systems and medical microbiology suggests the potential for viral influences on nutrient cycles, food web interactions, gene transfer, and other key processes in soils, very few empirical data are available.

Effect of Bacteriophages on the agricultural soil

- As reported in many aquatic environments, recent studies in terrestrial ecosystems implicate a role for viruses in shaping the structure, function, and evolution of prokaryotic soil communities.

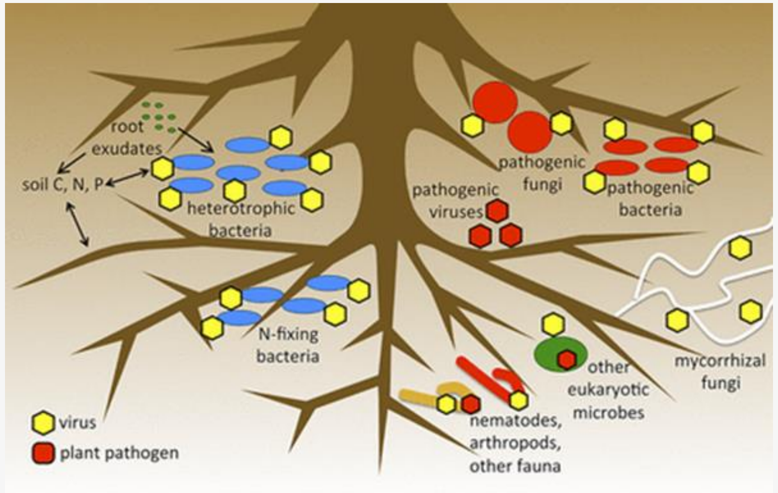
- However, given the heterogeneity of soil and the physical constraints (i.e., pore-scale hydrology and solid-phase adsorption of phage and host cells) on the mobility of viruses and bacteria, phage-host interactions likely differ from those in aquatic systems.

Effect of Bacteriophages on the agricultural soil

- In this study, temporal changes in the population dynamics of viruses and bacteria in soils under different land management practices were examined.
- The results showed that bacterial abundance was significantly and positively correlated to both virus and inducible prophage abundance.
- Bacterial and viral abundance were also correlated with soil organic carbon and nitrogen content as well as with C:N ratio.

- The seasonal variability in viral abundance increased with soil organic carbon content.

- The prokaryotic community structure was influenced more by land use than by seasonal variation though considerable variation was evident in the early plant successional and grassland sites.



- The free extracellular viral communities were also separated by land use, and the forest soil viral assemblage exhibiting the most seasonal variability was more distinct from the other sites.

- Viral assemblages from the agricultural soils exhibited the least seasonal variability.

History

- The first direct counts of agricultural soil viruses using epifluorescence microscopy were reported in 2003.

- Since that time various aspects of soil viral ecology have been examined in wetlands, forest soils, and extreme cold desert soils of Antarctica.

History

- Though viruses appear to be highly abundant in soils, relatively few studies have attempted to determine the extent to which soil microorganisms are infected by viruses.
- In sheep-grazed pasture soil, the frequency of viral infected cells (FVIC) as determined by transmission electron microscopy averaged 23% significantly higher than estimates for many aquatic environment.
- A similar investigation of a rice paddy system determined that the FVIC from soil exceeded that of the floodwater ranging from 4.2 to 11.4% (mean of 7.4%).

- Low nutrient turnover and inadequate release of nutrients from organic pools have become particular problems in cover-cropped systems, in which soil nitrogen tends to be immobilized (14), and viral lysis could conceivably play a key role in the liberation of nutrients tied up in microbial biomass.

- The use of phage therapy, i.e. using bacterial viruses to combat bacterial pathogens, has been explored for decades in humans and livestock, but has not been applied to plant pathology, where it seems that it would encounter far fewer obstacles of public perception than it has in humans.

There has been experimental work in using phage against food-borne bacteria in crops, and the most common food-borne bacteria can be infected by many different phage, indicating the feasibility of this approach in plants.

Lytic viruses of plant-pathogenic bacteria can be found in abundance in nature, and this approach has been attempted in a number of common bacterial diseases, including black rot in cabbage, citrus canker and fire blight, to name a few.

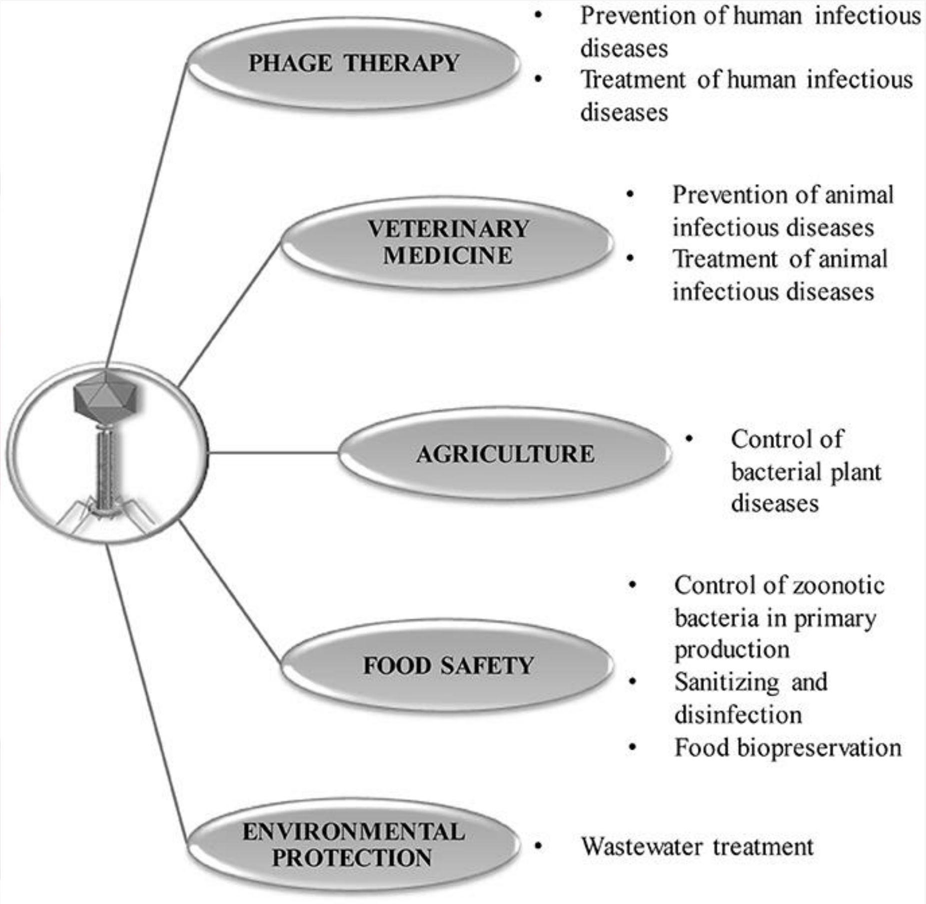
- There are some complications to this approach, perhaps most significant being the diversity of bacteria and the specificity of phage.

- However, phage therapy would provide a very safe, non-toxic approach to combating pathogens, which would probably be more effective than current strategies, and deserves further exploration.

- Phages are inherently highly specific towards bacterial hosts.
- This characteristic has both negative and positive aspects in that it is beneficial in terms of avoiding negative effects on the host microbiota and a hindrance when it comes to detection and elimination of the target pathogen. .

- The development of phages as antimicrobial agents in animal and plant production systems follows a similar path in the initial discovery stage however the processes become divergent in the implementation processes.

Applications of bacteriophage in different fields



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Thank you