Viruses in Soil

Maud Swanson, Gill Fraser, Tim Daniell, David Hopkins, Peter Gregory,
Lesley Torrance and Misha Taliansky

Soil viruses are potentially of great importance as they may influence the ecology and evolution of soil biological communities through both an ability to transfer genes from host to host and as a significant cause of microbial mortality.

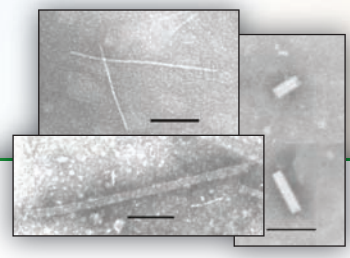
Despite this potential importance, very little information is available about the types of viruses present in soils, their abundance and their effects.

Virus-like particles in Dundee soils

Virus-like particles (VLPs) were isolated from fallow soils at SCRI using standard virus purification procedures and examined using a transmission electron microscope.

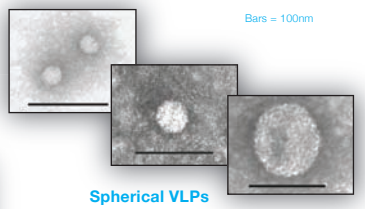
Results

Different virus morphotypes including tailed, spherical, rod-shaped, filamentous and bacilliform particles were detected in the soil samples. These were similar to known viruses infecting bacteria and fungi.



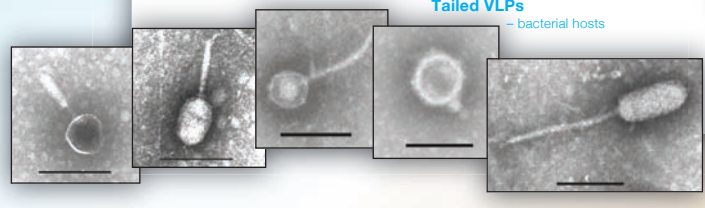
Filamentous and rod-shaped VLPs
– bacterial or archaebacterial hosts

Bars = 100nm



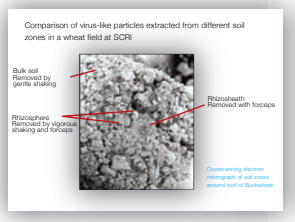
Spherical VLPs
– bacterial or fungal hosts

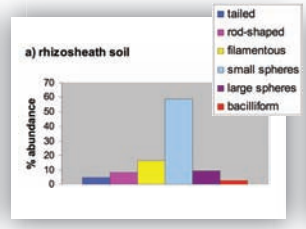
Tailed VLPs
– bacterial hosts

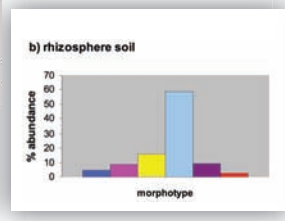


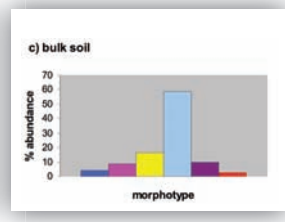
Comparison of VLPs extracted from different soil zones in a wheat field at SCRI

Numbers of bacteria and fungi are known to increase in the soil zone closely associated with the roots. Increased numbers here are due partly to the presence of exudates released by the roots which provide a source of moisture, nutrients and energy. The numbers and morphotypes of the VLPs present in the bulk soil, rhizosphere and rhizosheath from a wheat field at SCRI were compared.







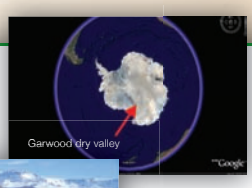


Results

There was no significant difference in the total number of virus-like particles counted from the different soil zones or in the percentage frequency of the different particle morphologies in each zone. There were approximately 1.2 x 10^9 VLPs per gram of dry weight soil for each soil.

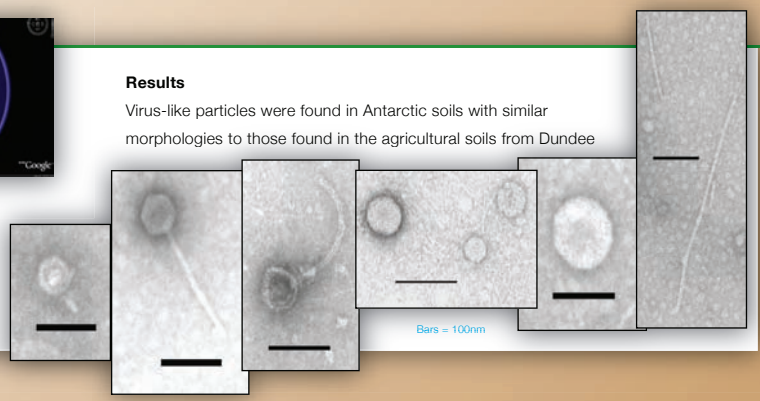
Viruses in Antarctic soil

We looked for the presence of viruses in soils from the Garwood dry valley in Antarctica. This region is extremely cold, dry and windy. There are no higher plants or animals and the soils have very little organic matter. However, bacteria and fungi grow in these soils when conditions are favourable.



Results

Virus-like particles were found in Antarctic soils with similar morphologies to those found in the agricultural soils from Dundee



Bars = 100nm

Virus particles from bacteria cultured from soil

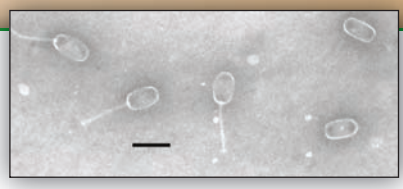
We cultured bacteria from various soils, grew up the bacteria in flasks and looked for the presence of VLPs in the growth medium after one to two weeks.

Results

In all soils tested, naturally occurring virus-infected bacteria could be found.

A Myovirus-like particle from a bacterial isolate cultured from garden soil. 16s rRNA sequencing indicates the bacterium is related to *Stenetrophomonas maltophilia*

Bars = 100nm



Siphovirus-like particles from a bacterial isolate cultured from Antarctic soil. 16S rRNA sequencing suggests that the bacterium is a *Streptomyces* species

Future work

Culturable bacteria/virus combinations will be used in future studies of the viruses and their effect on soil microbial ecology