HORTGRO
Growing Fruit IQ

Technical Symposium 2026

SESSION TWO
Shifting Landscapes: The Rise of Novel Pests and Pathogens

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Chair: Dr Nanike Esterhuizen | Hortgro

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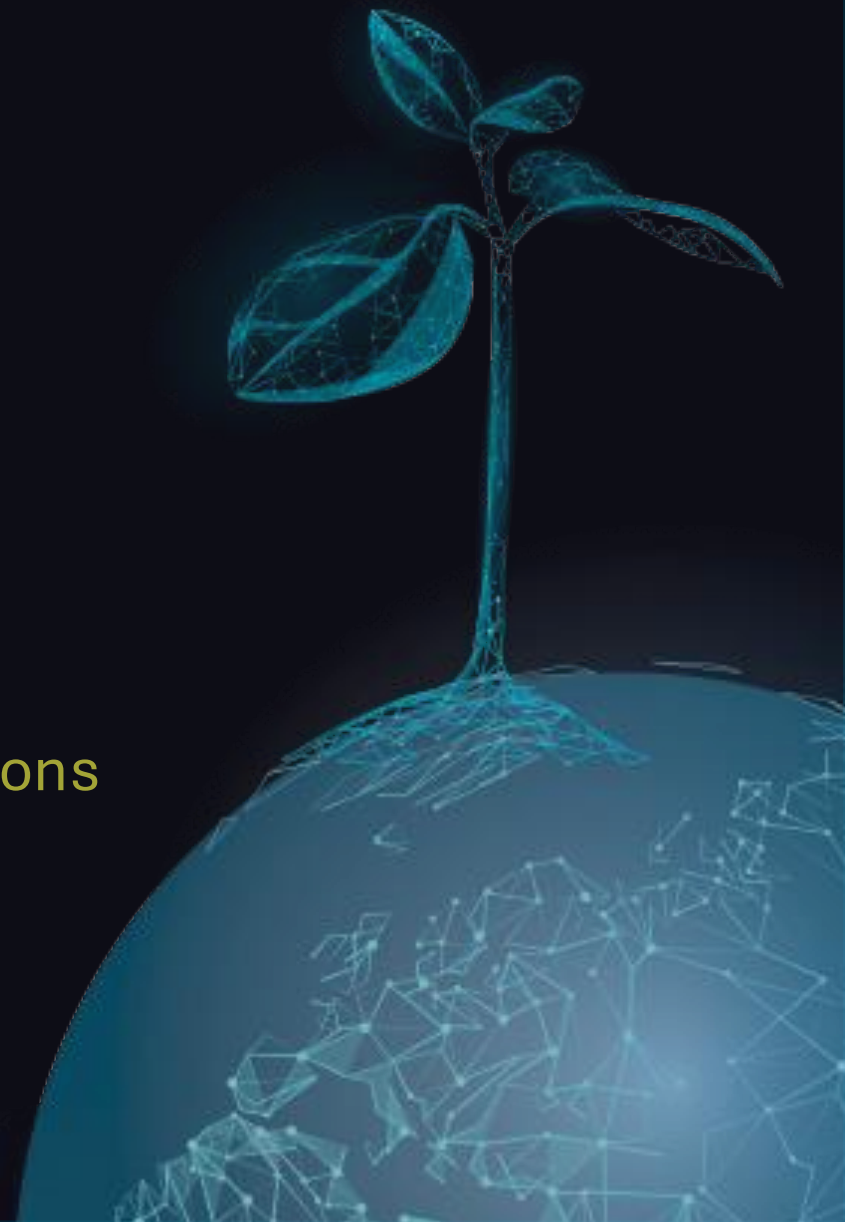
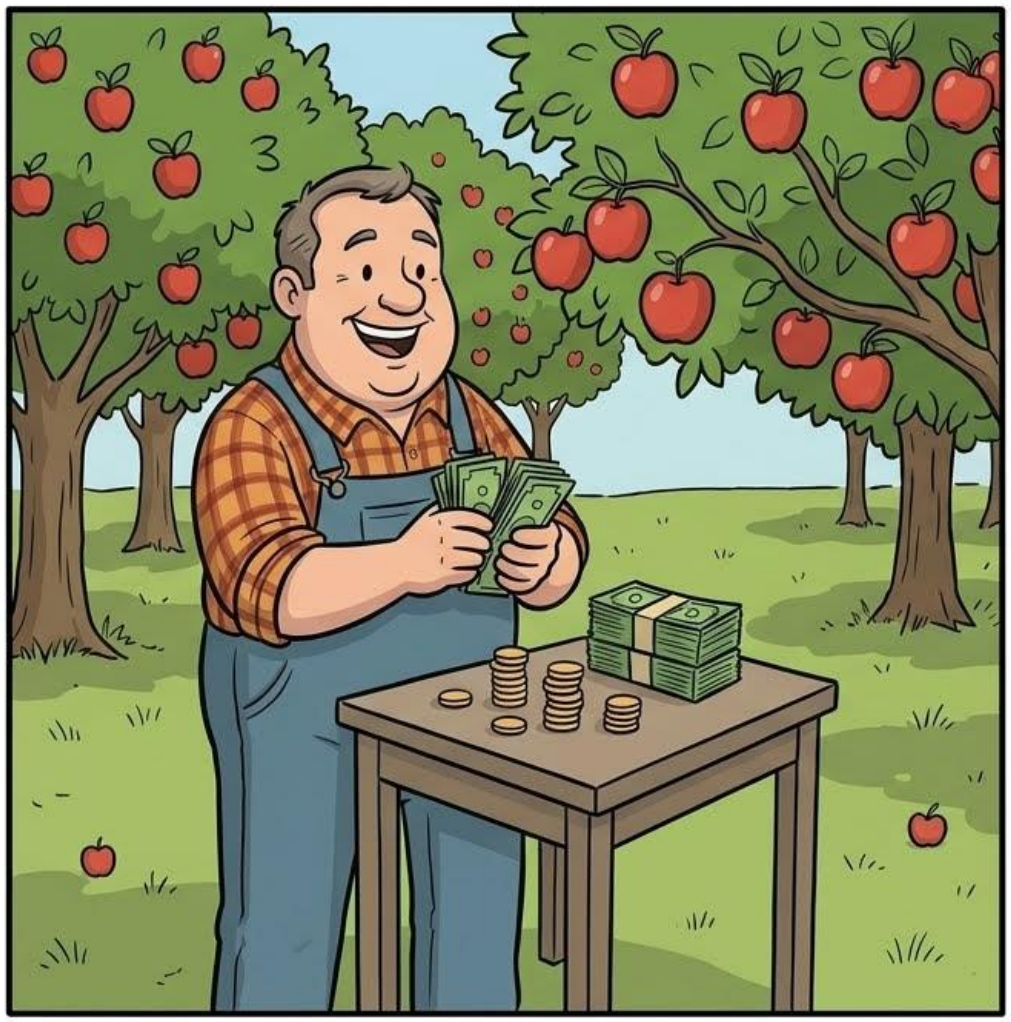
Technical Symposium 2026

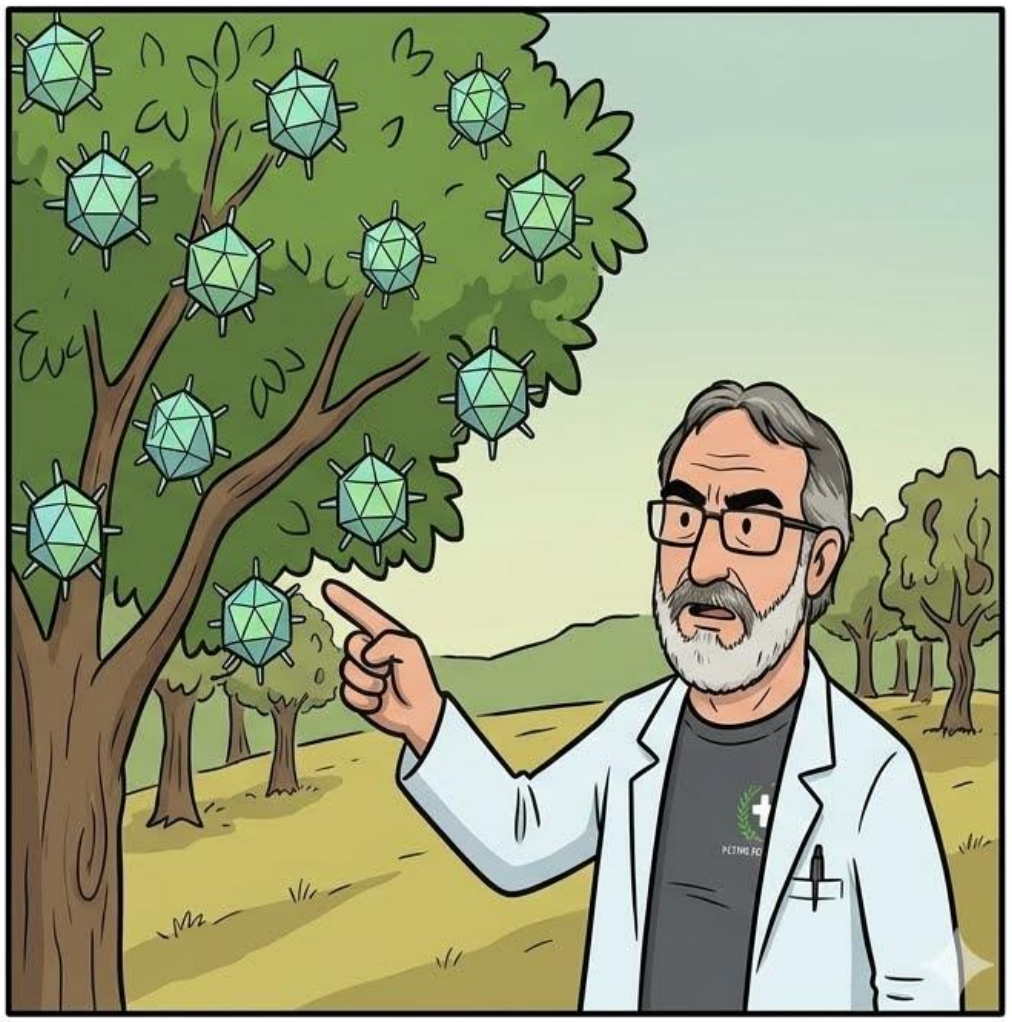
Viruses in your trees?

Prof. Gerhard Pietersen | Patho Solutions



Viruses in Your Trees?





PATHO SOLUTIONS

How High throughput sequencing (HTS) has changed plant virology, and the implications for horticultural crops.

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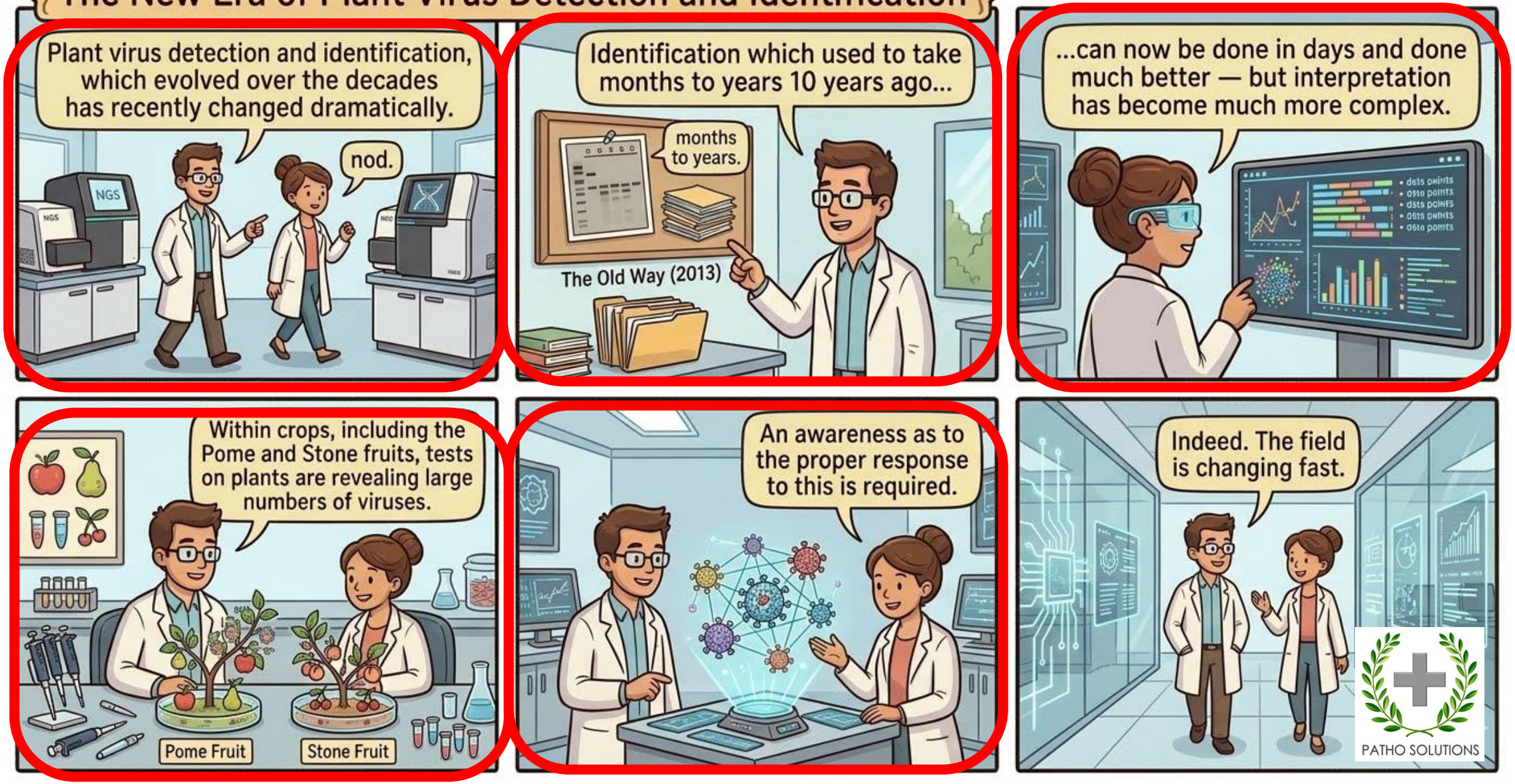
The New Era of Plant Virus Detection and Identification



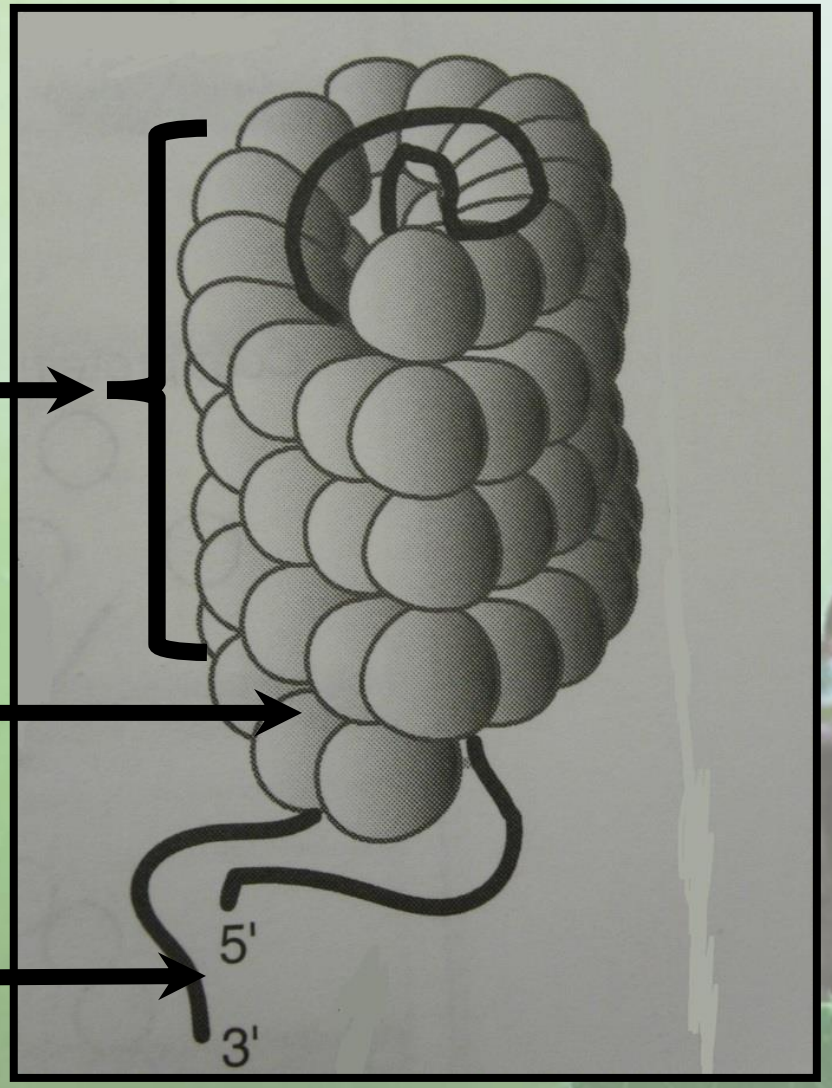
Detection of these viruses reflect changes in virus detection techniques over time.

Virus properties:

Virus particles: Electron microscopy

Virus proteins: Serology

Virus nucleic acids: Molecular Techniques



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Virus properties: Transmission, symptoms, host range, vector

1960s - : Biological indexing.

- **Grafted material onto indicator plants and waited for symptoms — often months.**
- **Could only test few trees.**
- **Didn’t detect latent or symptomless plants.**
- **Advantage revealed disease causing viruses**

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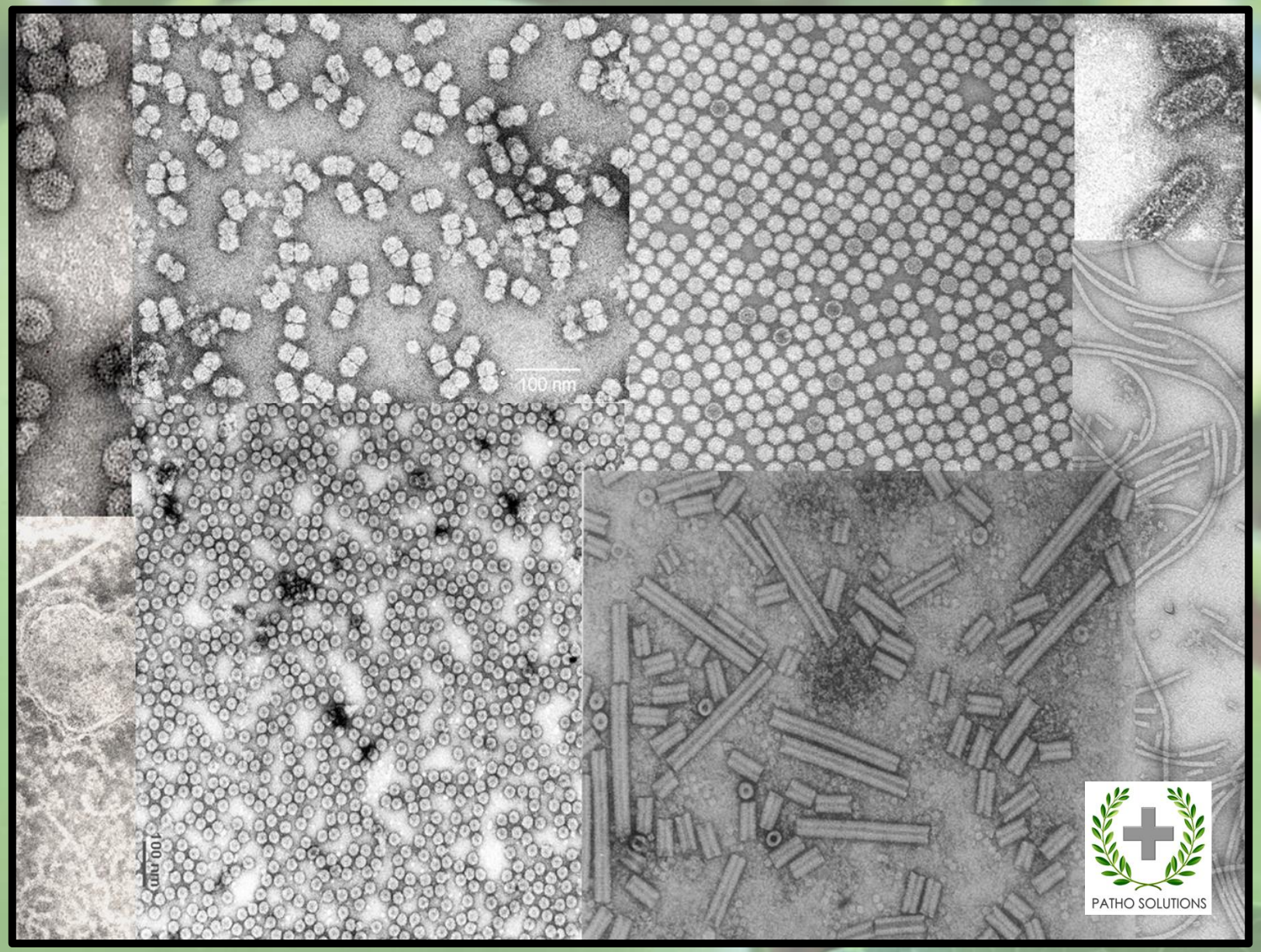
1970s–90s Virus particles: Electron microscopy.

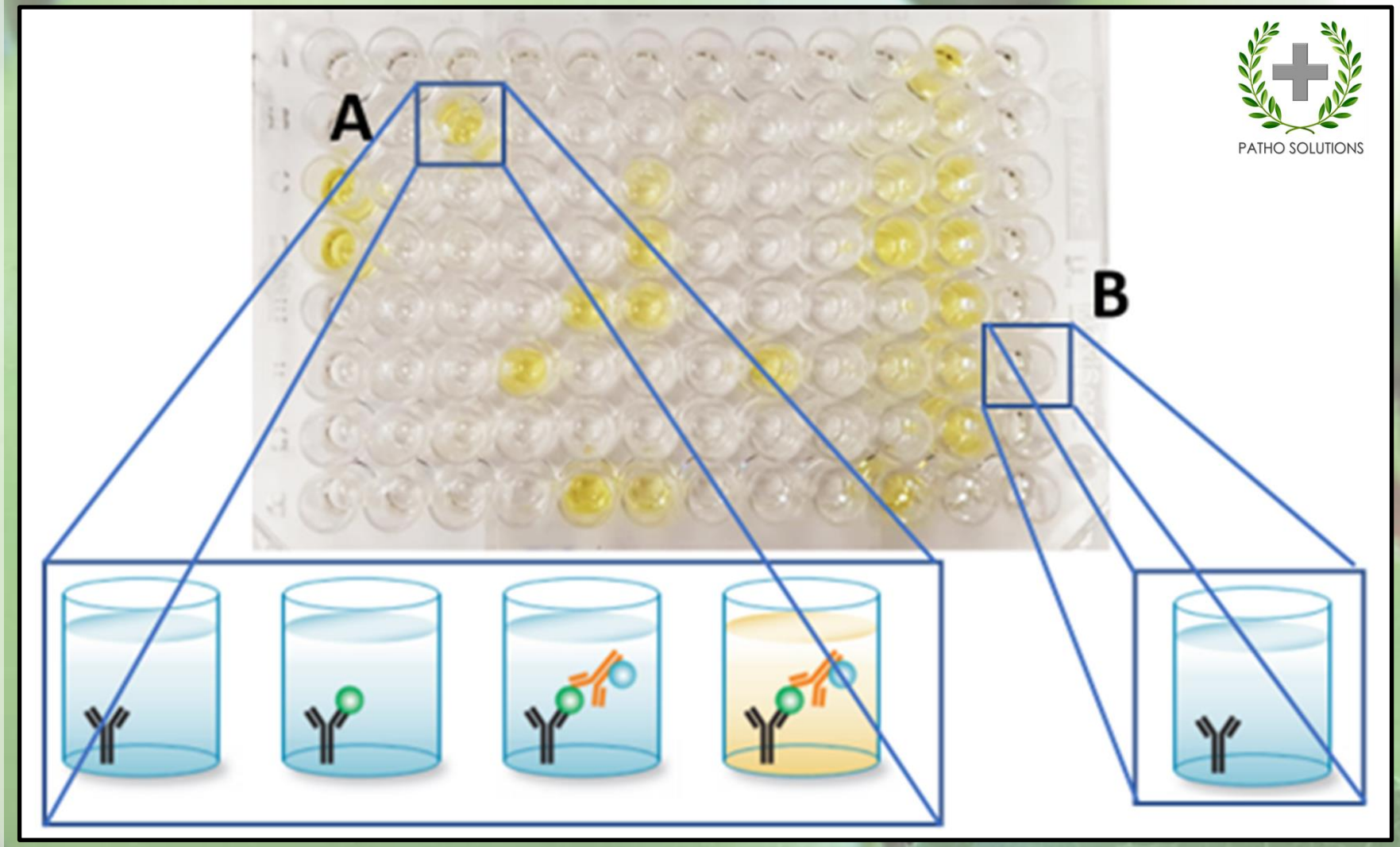
- **Could see virus particles but couldn’t easily identify which virus.**
- **Very expensive.**
- **Could only test small number of samples.**



1980s– : Detect virus proteins (used antibodies).

ELISA: Excellent for large scale testing.

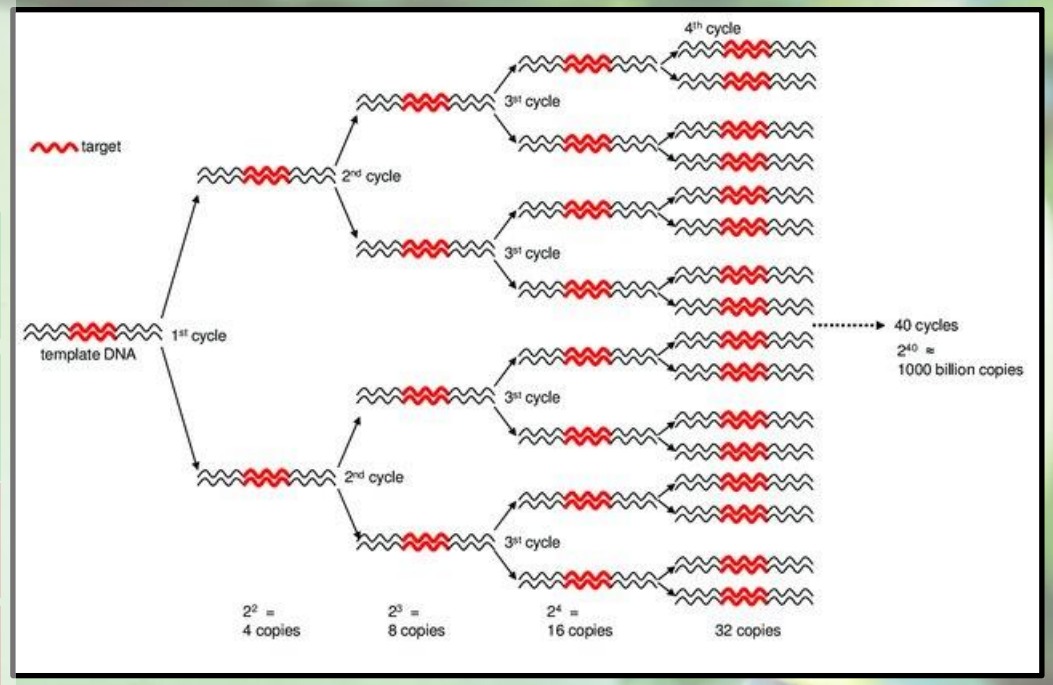
Relatively low sensitivity. Could miss virus when titers low (seasonal detection, distribution in plant erratic).

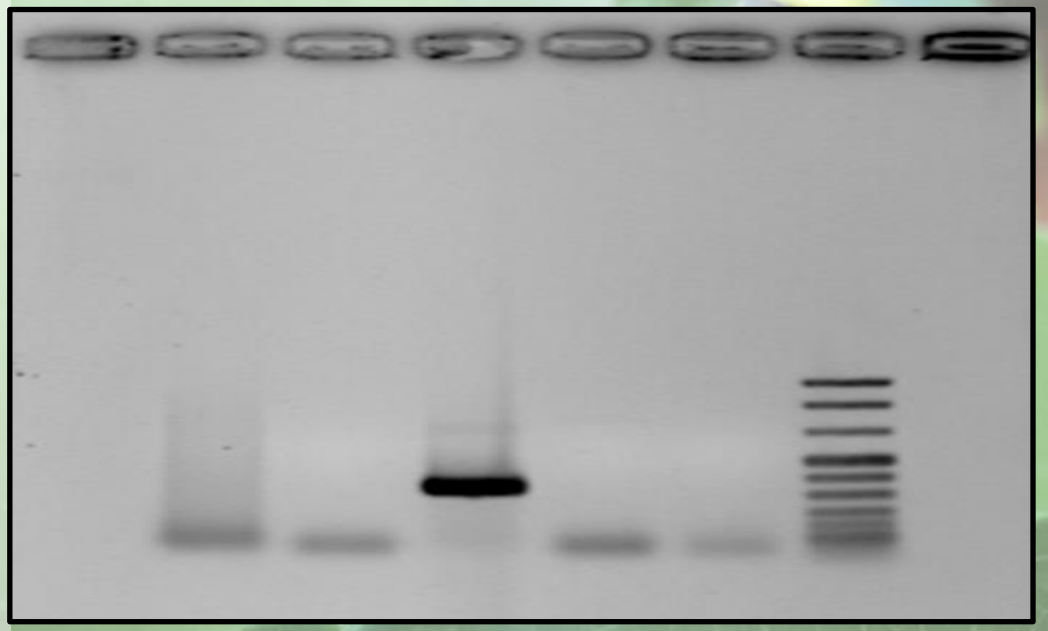


1990s–: Detect viral nucleic acid.

PCR:

- **Much more sensitive/easier to establish.**
- **Amplified specific viral sequences.**
- **Relatively expensive. Not as robust as ELISA**
- **Technically more difficult than ELISA.**
- **Need to have a sequence available for the virus we were detecting.**
- **Becoming increasingly better as more viral sequences becoming available.**
- **Recently, more feasible on larger scale (real-time PCR, automation)**





Traditional Virus Detection

All these methods were targeted — you could only find the virus(es) you were looking for.

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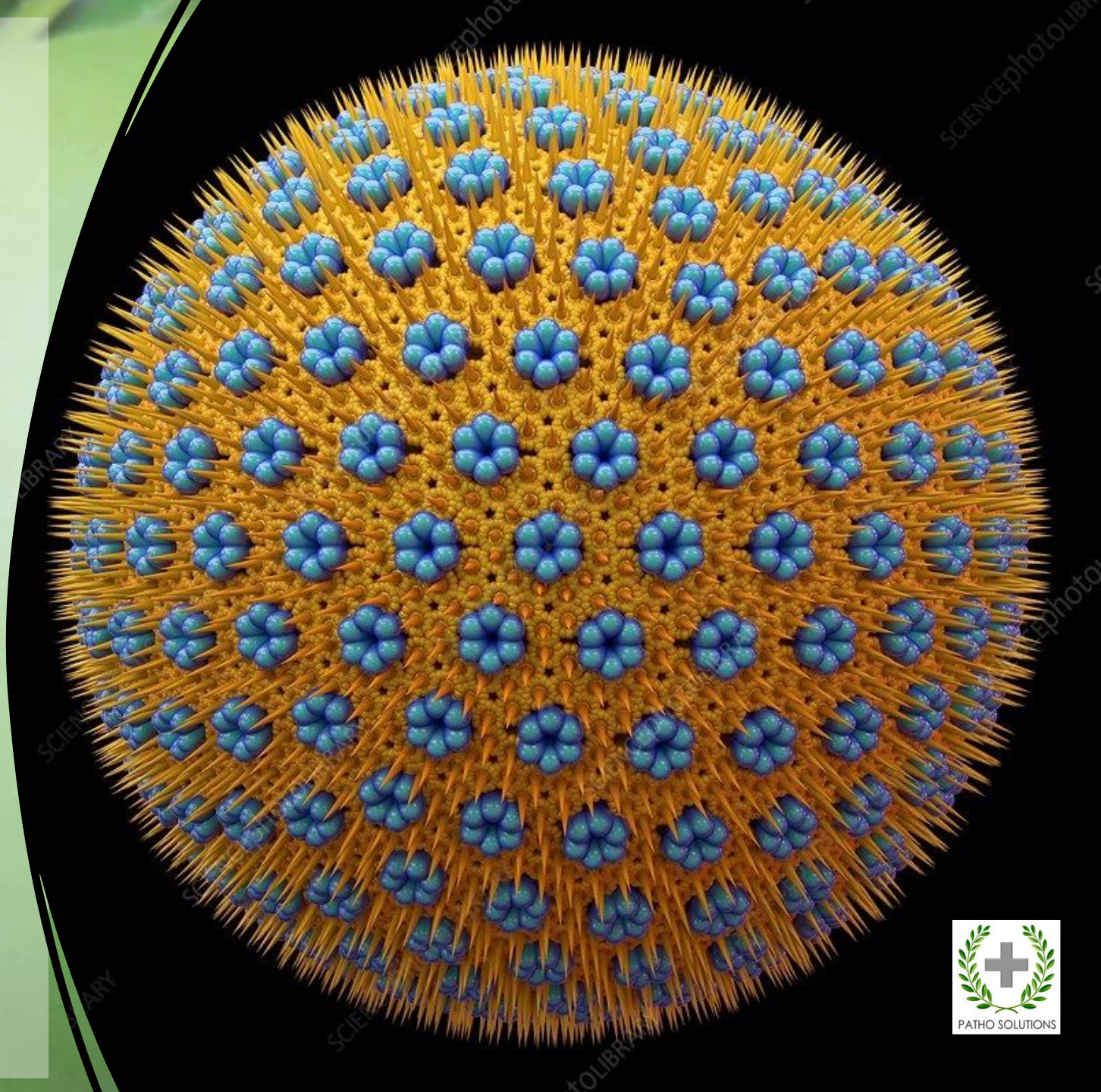
The Game Changer: *High throughput sequencing (HTS), also known as next generation sequencing (NGS).*

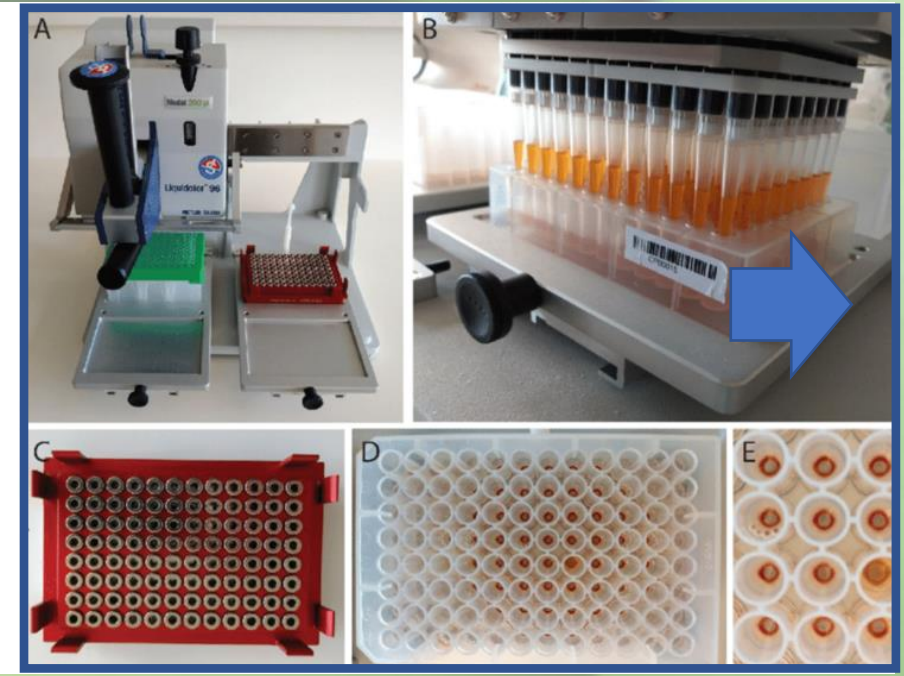
Not just specific virus(es) at a time.

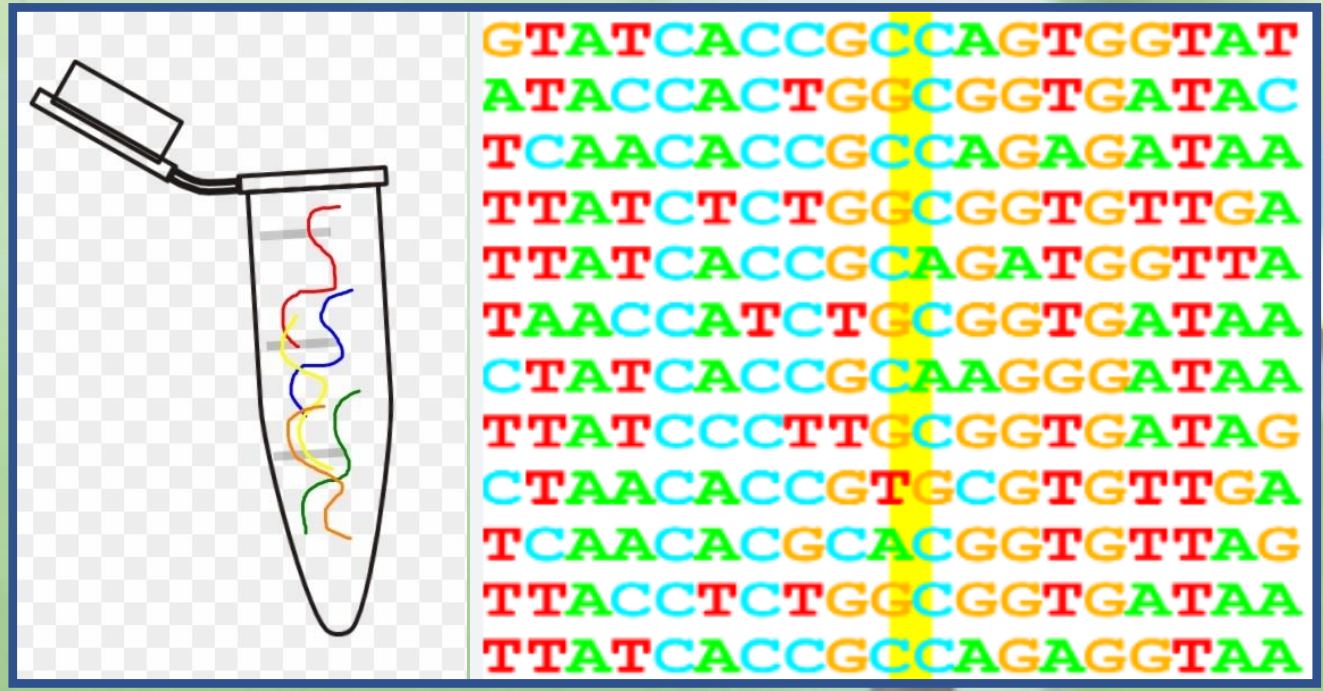
Not limited to known viruses.

Can detect ALL the viruses in a sample (known viruses, variants of known viruses or viruses distantly related to known viruses).



High throughput sequencing (HTS) for virus detection





Extract nucleic acid

Sequence all the nucleic acid in extract (plant, viruses, bacteria, fungi).

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Millions of reads

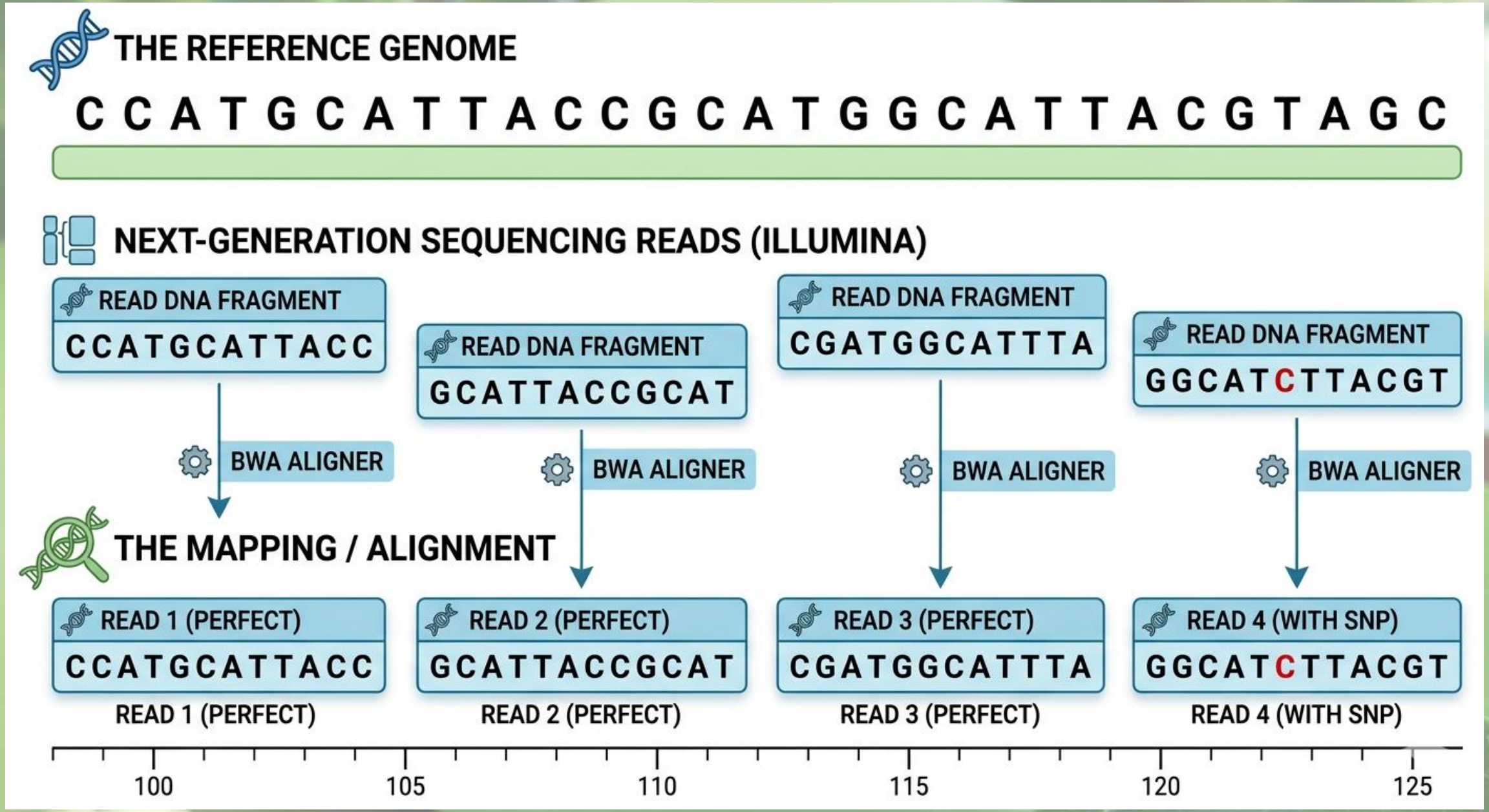
NIH National Library of Medicine
National Center for Biotechnology Information

GenBank Virus references

Assembly of Reads to form larger contigs

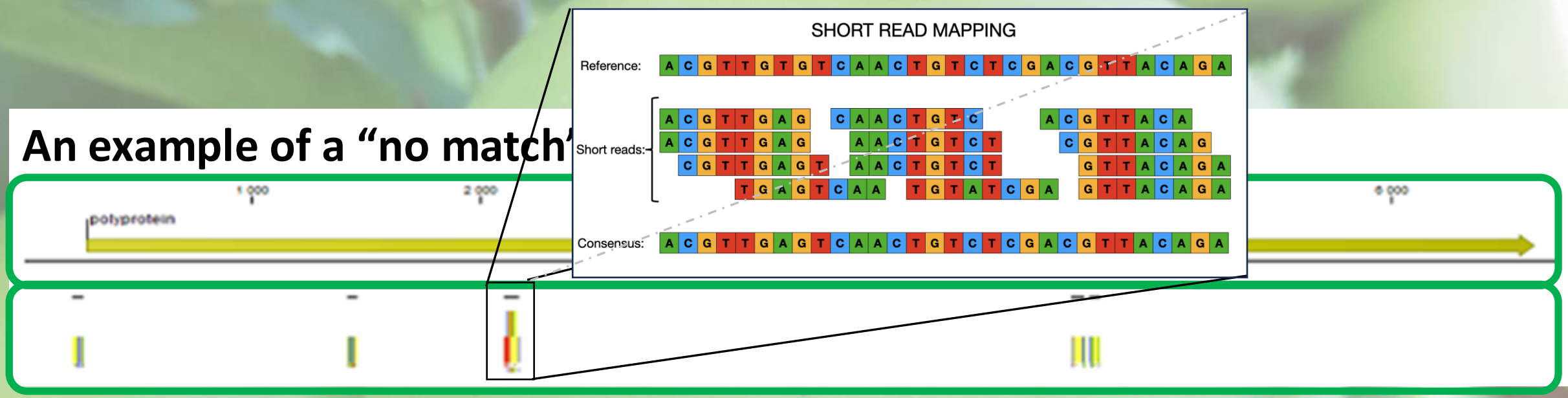
REFERENCE GENOME

ALIGNMENT/MAPPING

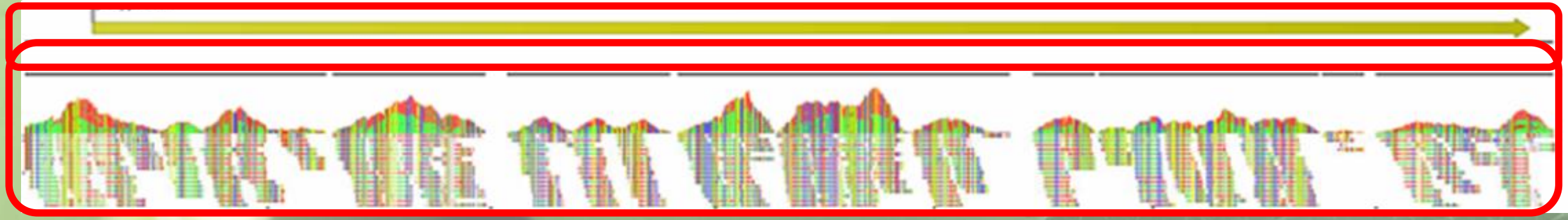

THE REFERENCE GENOME
C C A T G C A T T A C C G C A T G G C A T T A C G T A G C
NEXT-GENERATION SEQUENCING READS (ILLUMINA)
READ DNA FRAGMENT
CCATGCATTACC
BWA ALIGNER
READ DNA FRAGMENT
GCATTACCGCAT
BWA ALIGNER
READ DNA FRAGMENT
CGATGGCATTTA
BWA ALIGNER
READ DNA FRAGMENT
GGCATCTTACGT
BWA ALIGNER
THE MAPPING / ALIGNMENT
READ 1 (PERFECT)
CCATGCATTACC
READ 2 (PERFECT)
GCATTACCGCAT
READ 3 (PERFECT)
CGATGGCATTTA
READ 4 (WITH SNP)
GGCATCTTACGT
READ 1 (PERFECT)
READ 2 (PERFECT)
READ 3 (PERFECT)
READ 4 (WITH SNP)
100
105
110
115
120
125

Match against thousands reference sequences of plant virus species

An example of a “no match”



An example a positive match: Virus “B”



HTS has revolutionized plant virology — we now detect viruses that were not detectable before.

Consequently, discovering new viruses regularly and discovering viruses in plants previous thought healthy.

Interpretation of findings more complex than with targeted detection methods (variants, strains, related viruses, novel viruses).

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Through a combination of PCR and HTS a number of previously unreported viruses and viroids of pome and stone were found in South Africa during the last few years:

Apple rubbery wood virus 1
Apple rubbery wood virus 2
Apple green crinkle- associated virus (ASPV variant)
Citrus concave gum associated virus
Citrus virus A
Citrus jivi-related virus
Hop stunt viroid
Plum viroid -1 (plum marbling)

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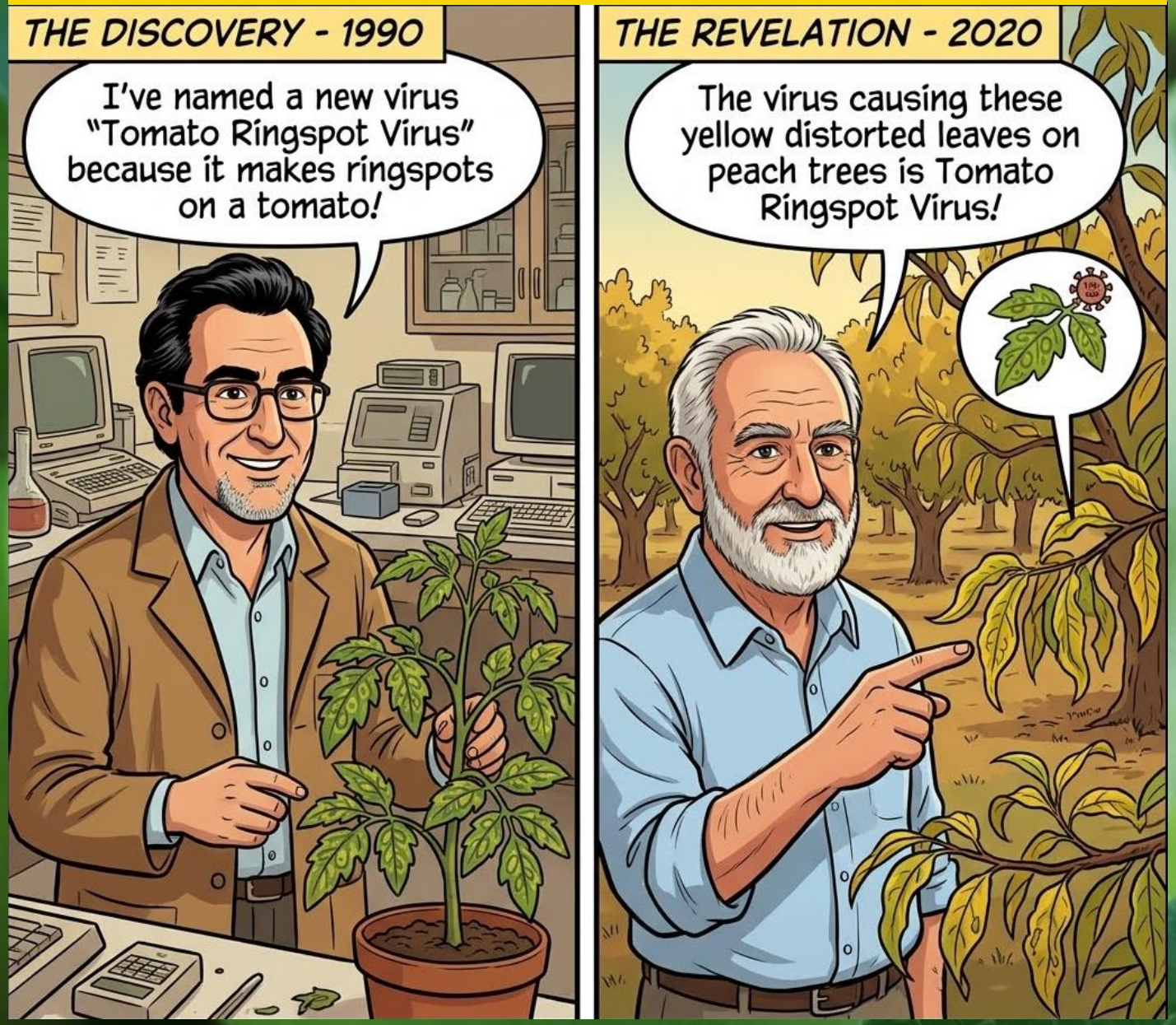
The logic(?) of plant virus names



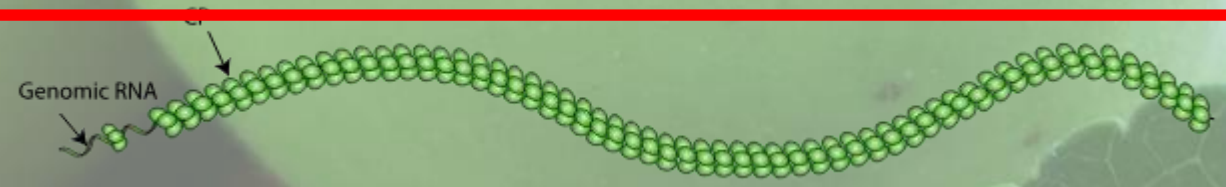
Limitations of HTS:

HTS tells us which viruses are *present*, not which ones are *causing symptoms*.

Trees, especially older ones, often carry several latent or symptomless viruses.

The presence of a virus in a number of trees with a specific symptom but absent in other trees without symptoms is considered an *association*, not proof of *causation*.

Determining causation requires controlled experiments



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Don’t panic when you see a list of viruses in your trees.

It’s tempting to worry, but many of the viruses may have only limited effects.

Many of these viruses may have been present for a long time already, just not detected and identified.

The real risk is overreacting — removing trees or making management decisions based on incomplete information.

Always interpret HTS results with expert input.

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Challenges for Plant Virologist today.

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HTS has uncovered hundreds of new plant viruses.

For most, we don't know the extent to which they cause disease, reduce yield, or affect quality.

Viruses often occur together in mixed infections. Difficult to find single viruses infecting plants to test for causation.

Testing yield and quality impacts requires replicated field trials over years (also with single viruses). Also, must do trials with virus combinations (some cause diseases only when combined).

Hence, many NGS-detected viruses remain uncharacterized in terms of their biological significance.

Best solution: Certification Schemes.

- We won't always know which viruses matter yet,
- The safest approach is to start with uninfected material.

Certification programs:

- Use NGS to detect all known and novel viruses.
- Eliminate as many as possible via:
  - Meristem tip culture,
  - Heat or cold therapy,
  - Tissue culture techniques.
- Propagate virus-tested, as uninfected planting material as possible.

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DECIDUOUS FRUIT PLANT IMPROVEMENT ASSOCIATION

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Incorporate NGS tests on nuclear material in the certification scheme.

Establish expertise in virus elimination (SAPO, TFC-Bernheim, Patho Solutions).

Implementation on new material entering scheme. Also, retrospective tests on existing material, re-introductions.

IPO Owners of cultivars to subject material for certification.

Encourage growers to only purchase certified planting material.

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Dankie!

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