RNA-based antiviral for Plant Virus

Prelims (GS I) - *General Science| Current events of national and international importance.*

Mains (GS III) – *Science and Technology- developments and their applications and effects in everyday life.*

Why in news?

Researchers recently reported developing an RNA-based antiviral agent that confers strong protection against cucumber mosaic virus (CMV).

- **Plant virus** – It is a ***microscopic, infectious agent*** that causes diseases in plants.
- It destroys a significant portion of annual crops worldwide.
- Unlike bacteria or fungi, viruses ***cannot be controlled*** with pesticides or fungicides.
- **Cucumber Mosaic Virus (CMV)**
- CMV is a plant virus that infects more than 1,200 plant species, including critical food crops like cucumbers, squash, and cereals, and medicinal plants.
- **Spread through -** *sap-sucking insects called aphids.*
- **Effects -** Infected plants develop mosaic discoloration, stunted growth, and commercially unviable fruits.
- **Severity -** Nearly 90 aphid species are capable of transmitting CMV, making outbreaks difficult to contain.

In India, CMV causes 25-30% yield losses in banana plantations.

Current RNA-based Crop Protection Techniques
• **RNA Silencing –** It is a ***natural defense mechanism*** in plants. • When a virus infects a plant, it introduces *double-stranded RNA (dsRNA)*. • The plant responds by activating Dicer-like enzymes (DCLs), which slice the dsRNA into small fragments called *small interfering RNAs (siRNAs)*. • These siRNAs guide the plant's defense system to recognize and destroy viral RNA. - **Limitations** – Not all siRNAs are effective, and some plant viruses can mutate rapidly. • **Host-induced gene silencing (HIGS)** – It works by *genetically modifying plants* to produce virus-fighting dsRNA in their cells. - **Limitations** - High production costs. • **Spray-induced gene silencing (SIGS)** - More flexible alternative to HIGS where plants are treated with *RNA sprays* instead of being genetically modified. - **Limitations** - Traditional dsRNA Spray formulations produce a random mix of siRNAs, and many are ineffective.

Key Findings of the Research

- Researchers first screened and identified the *most potent siRNAs* against CMV.
- These specially selected siRNA bind to the virus's genetic material to trigger a stronger antiviral response.
- Then they designed *effective dsRNA (e-siRNAs)* enriched with *highly functional siRNA*.
- These e-siRNAs were assembled into dsRNA constructs for more *targeted protection*.
- CMV infected plants treated with the *enhanced siRNA had* almost *80% lower viral load.*
- The new dsRNA formulation outperformed traditional dsRNA and it is effective against multiple CMV strains.

Advantages of the New Approach

- More *precise targeting of viral particles* of the most vulnerable genetic regions.
- Stronger defense by targeting multiple regions of viral genome simultaneously.
- The effective dsRNA can be redesigned in about a month to target new viral strains.

Reference

The Hindu| RNA-based antiviral

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