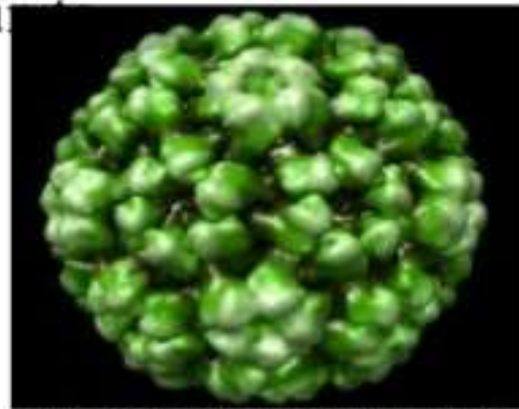


# INTRODUCTION:

- The first plant virus shown to have a DNA genome and the first shown to replicate by reverse transcription.
- Worldwide but only causes significant losses locally.
- It is transmitted by aphids .
- Type member of the Caulimovirus genus, contains 11 species and 6 possible members.
- significantly impact on plant virology and plant molecular biology.
- The virus is an important source of gene regulatory elements, used exclusively in the genetic manipulation of plants.

# Cauliflower Mosaic Virus

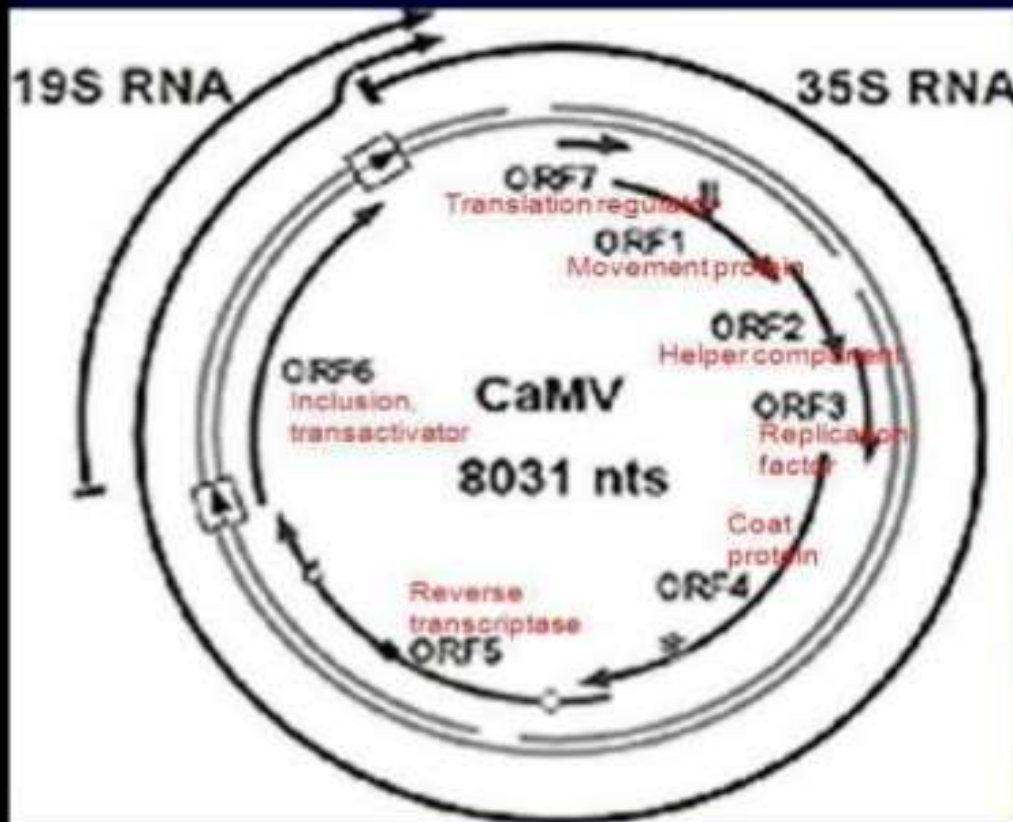
- **CaMV** is a plant virus that infects mostly brassicaceae family( cauliflower and turnips) and Solanaceae species
- CaMV is transmitted in a non circulatory manner by aphid species *Mysus*
- It is a *icosahedron* structure with a diameter of 52nm built from 420 cap protein subunits



Cauliflower Mosaic Virus. PDB: 1A20 from Lomon et al. (2002). J Mol Biol. 317: 93-104. Rendered with UCSF Chimera. Images © 2012 JF Sprott, UW-Madison.

# GENOME:

## Cauliflower mosaic virus genome structure



- Seven ORFs on CaMV genome
- Translation of seven proteins from two transcripts
- ORF 2 is the only dispensable ORF
- ORFs 6 and 7 are involved in translation regulation
- Packaged genomic DNA has discontinuities on both strands
- Replication is from tRNA<sup>met</sup> primer



## PLANT VIRUS VECTORS

- Plant viruses are considered as efficient gene transfer agents as they can infect the intact plants and amplify the transferred genes through viral genome replication.
- It has some limitations like that vast majority of plant viruses have genome not of DNA but of RNA. Two classes of DNA viruses are known to infect higher plants, caulimovirus and geminivirus & neither is ideally suited for gene cloning.

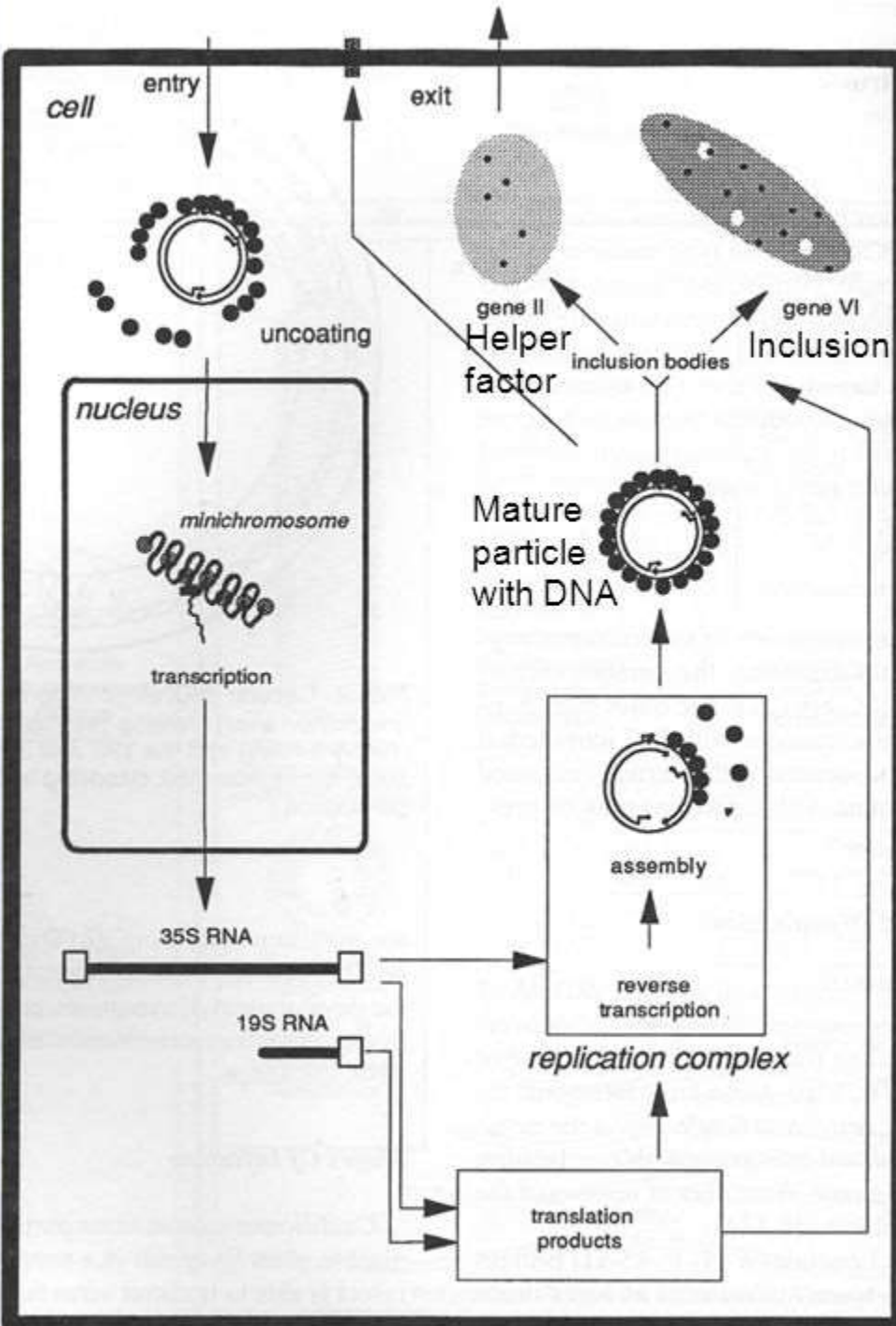
### 1) CAULIMOVIRUS:

They contain circular dsDNA and are spherical in shape. The caulimovirus group has around 15 viruses & among these Cauliflower Mosaic Virus(CaMV) is the most important for gene transfer.

CaMV infects many plants & can be easily transmitted. The infection is systemic. It's genome does not contain any non-coding regions.

# Caulimovirus Life Cycle

- Virus enters plant cell, capsid protein is removed
- dsDNA enters nucleus; gaps closed; transcription to 35S and 19S RNAs
- In the cytoplasm, the 19S RNA is translated to produce protein that forms inclusion bodies
- Five ORFs are translated from 35S RNA by complex combination of strategies
- Other copies of 35S RNA are reverse transcribed and packaged into virions
- Particles exit cells through plasmodesmata or by aphids



(Shaw, Fund. Virology, 3<sup>rd</sup> Ed., 1996)



# HISTORY

- **Beijernick** ( 1897) coined the latin name “VIRUS” meaning **Poison**. He studied plant juices and found they caused healthy plants to become sick.
- **Wendell Stanley** (1935) crystallized sap from sick Tobacco plants. He discovered viruses were made of nucleic acids and proteins.



## Family: Geminiviridae

- Genome: circular single stranded DNA 2.5–3.0 kb in length, encapsidated in twinned (gemininate) quasi-isometric particles.
- Responsible for several devastating diseases in economically important crops of both monocotyledonous and dicotyledonous plants worldwide (Cassava, maize, wheat, tomato, pepper, bean, cotton, etc.)

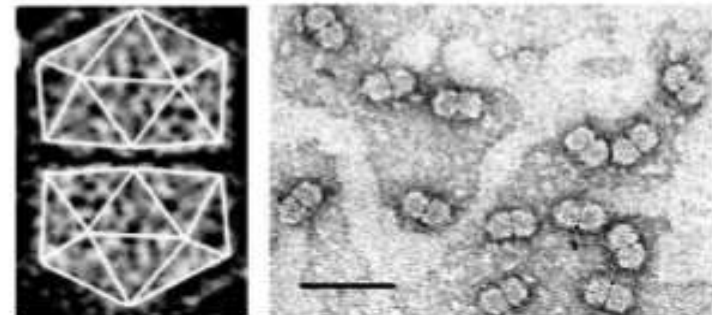
## Genera:

Begomovirus: ACMV, BGMV

Mastrevirus: MSV

Curtovirus: BCTV

Topocuvirus: TPCTV



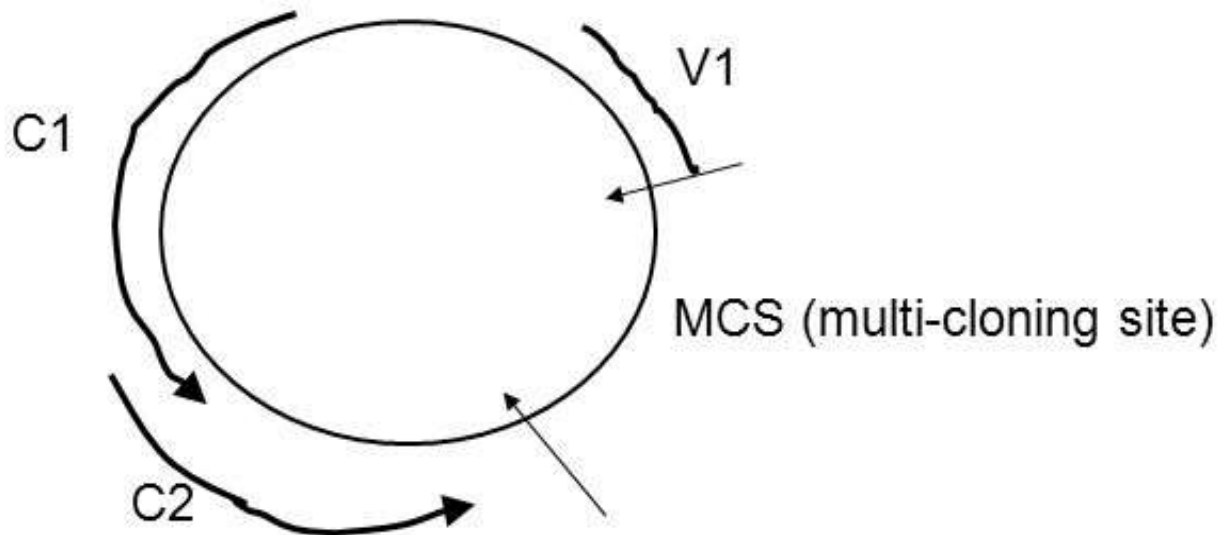
# Gemini viruses

dsDNA form of virus genome is infectious and coat protein gene is not required for systemic infection

Most have insect mediated transmission. No mechanical transmission.  
Overcome by cloning viral genome into Ti plasmid and carrying out “Agroinfection”

WDV genome allows insertion of up to **3 kb** foreign sequence

pWDV2 V2 deletion vector



## II. Gemini viruses

- Gemini viruses are small circular DNA viruses that replicate in plant nuclei. The Gemini virus vectors lack a coat protein gene, they are not transmissible by insect vectors, which are required for plant-to-plant spread and, thus, use of the disarmed vectors does not require a permit.
- Viruses from the Gemini virus family normally infects a wide range of crop plants, including maize, cotton, wheat, bean and cassava and are, therefore, an ideal system of choice for VIGS-based gene function analyses in a broad range of crop plants.
- Now vectors have been developed for use in cotton, and work is also ongoing for suitable vectors for roses. Using these new VIGS vectors, recombinant virus bearing a partial sequence of a host gene is used to infect the plant.
- As the virus spreads, the endogenous gene transcripts, which are homologous to the insert in the viral vector, are degraded by post-transcriptional gene silencing. These VIGS virus vectors have been used in a range of studies to silence single or multiple genes, including the meristematic gene, Proliferating Cell Nuclear Antigen (PCNA).



*Nepovirus-Tobacco ringspot virus (TRSV)*

**Family: Comoviridae**

**Hosts:**

*Cucumis sativus*,  
*Glycine max*,  
*Lycopersicon*  
*esculentum*, *Nicotiana*  
*tabacum* — necrotic  
spots, mottling,  
chlorotic ringspots and  
vein banding.



Virginia Tech Learning Resources Center, Virginia Polytechnic Institute and State University, Bugwood.org

*Tobacco ringspot virus symptoms on tobacco*  
Virginia Tech Learning Resources Center, Virginia



Florida Division of Plant Industry Archive, Florida Department of Agriculture and Consumer Services, Bugwood.org

*Tobacco ringspot virus symptoms on bean*

# MODE OF ENTRY

- Mechanically      TMV, BCMV, PVX, PYDV.
- Vectors              PLRV, TLCV, WTV.
- Pollen Grain        necrotic ring spot, ring spot of soybean.
- Seeds or vegetative:  
Propagation        BCMV, CMV, Pea stripe virus.
- Pinocyte             CPMV, Pea enation mosaic
- Fungal parasite TNV, Barley yellow mosaic virus,  
Tobacco stunt virus.
- Ectodesmata        TMV.
- Epidermal hair    TMV.



# Symptoms

- **Yellowing and vein-clearing on young leaves**
- **Yellow mottling of the leaves, severe blistering and leaf distortion**
- **Dark-green streaks and rings in the leafstalks and stems**
- **Concentric rings and spots or C-shaped markings, a darker green than the background green fruit color**
- **Can affect vigor of fruit and trees and fruit quality**



- The cucumber mosaic virus is transmitted from plant to plant by several different kinds of **aphids**.
- Cucumber mosaic is readily transmitted mechanically on the hands of workers in the cucurbit patch and by aphids.



# CUCUMBER MOSAIC VIRUS

- ◉ Infects cucumber, tomato, peppers, melons, squash, spinach, celery, beet and other plants
- ◉ Aphids spread it, and they cause physical damage to the plant
- ◉ Allows entry of the virus via wind, splashing or dripping sap
- ◉ Causes twisting in young leaves that stunts growth of the entire plant and causes poor fruit or leaf production



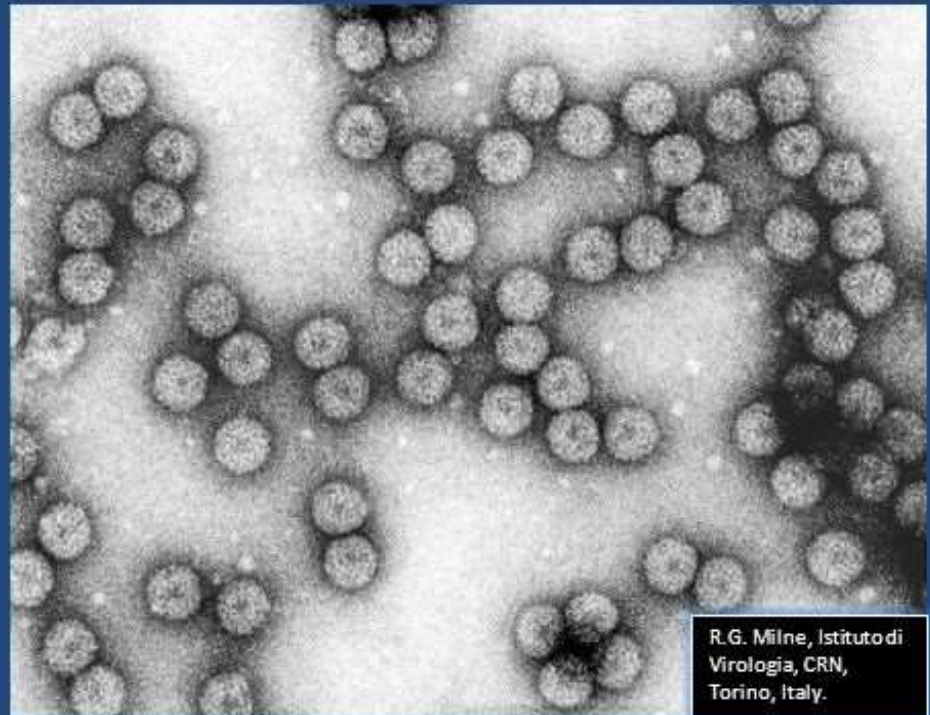
## *Cucumovirus* - *Cucumber mosaic virus (CMV)*

**Family: Bromoviridae**

### **Description:**

Virions consist of a capsid. Virus capsid is not enveloped, round with icosahedral symmetry. The isometric capsid has a diameter of 29-29.33-30 nm. Capsids appear round, or hexagonal in outline. The capsomer arrangement is clearly visible, or is not obvious. The capsid consists of 32 capsomers. Virus preparations contain more than one particle component.

Capsids all have the same appearance. (ICTV database).



# DISEASES

## 4. Cucumber Mosaic

- **Casual agent:** CMV – Cucumber Mosaic Virus
- **Symptoms:**
  - Mosaic pattern of light and dark green (or yellow and green) on the leaves
  - Yellow streaking of leaves
  - Ring-spots or line patterns on leaves or fruit
- **Control measures:**
  - Controlling vectors (Aphids)
  - Purchase virus-free plants
  - Discard virus infected plants
  - Disinfest tools used for vegetative propagation frequently [\[4\]](#)



Scott Nelson, Flickr CC-licensed



**Alfalfa mosaic virus (AMV)**, also known as *Lucerne mosaic virus* or *Potato calico virus*, is a worldwide distributed [phytopathogen](#) that can lead to [necrosis](#) and yellow mosaics on a large variety of plant species, including commercially important crops. It is the only *Alfamovirus* of the *Bromoviridae* family. In 1931 Weimer J.L. was the first to report AMV in [alfalfa](#) (*Medicago sativa*). Transmission of the virus occurs mainly by some [aphids](#) (plant lice), by seeds or by pollen to the seed.<sup>[1] [2]</sup>



## Transmission[[edit](#)]

vectors are insects of the order [Hemiptera](#), family [Aphididae](#); green peach aphids ([Myzus persicae](#)) and at least 14 other species are known to play that role. AMV can also be transmitted by seed, pollen, through mechanical [inoculation](#) of plant sap and by the parasitic plant dodder (*Cuscuta*). The combination of seed-infected plants and spreading by aphids results mostly in high levels of infection.

## Economic importance[[edit](#)]

The host range of the virus is wide and includes food and pasture crops (peas, lentils, potatoes, clovers,...). Infection by AMV causes important yield losses, reduces winter survival and facilitates infection of the affected plant by other pathogens.<sup>[14]</sup>