

# Viruses in Camellias

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**In plants all viruses are graft-transmissible agents**

**but**

**Not all graft-transmissible agents are viruses**

As you are all well aware camellias are perennial plants, have been cultivated for thousands of years, and although new cultivars are derived from crosses, camellias are by and large asexually propagated.

Some cultivars have long histories and have travelled the world.

Viruses are graft-transmissible (100%)

These statements are important when considering the potential role of viruses and the “diseases” they might cause in camellias.

**A perennial plant is exposed each year to infection by viruses.**

**In the growing season viruses are transmitted by:**

**Insects**

**Nematodes**

**Fungi**

**As such, long-lived plants can accumulate viruses and symptom expression may change.**

**Acute symptoms** - the symptoms that are displayed in the growing season during which the infection takes place.



**Chronic symptoms** (latent , or cryptic infections) – the symptoms that are displayed in growing seasons subsequent to the initial infection.

Viruses can interact with each other to cause different symptoms.



PNRSV  
PNRSV + PDV

PDV



Viruses can cause changes in the appearance of flowers – color breaking (variegation) .



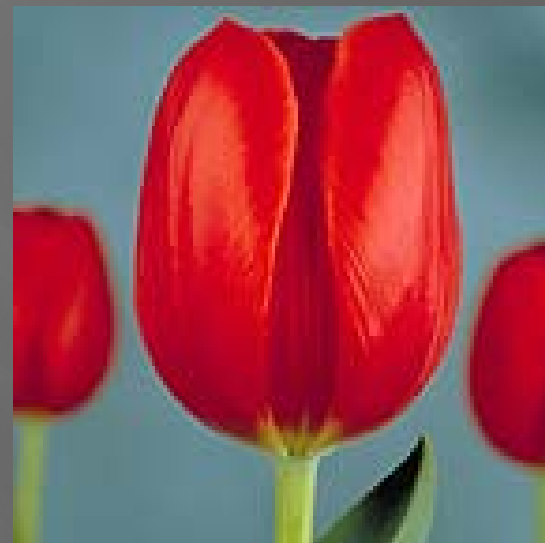
Rembrandt Tulips

Tulip mania

Holland

1593-1637

*Painting by Jan Davidsz de Heem, "Festoon with Flowers and Fruits", 1670*



P. Gentil, Clif, France



During the period in which Tulip mania was active,

A single Viceroy tulip bulb was exchanged for goods valued at 2,400 florins.

4 tons of Wheat	4 barrels of Beer
8 tons of Rye	2 Barrels of butter
4 fat oxen	1000lbs of cheese
8 fat pigs	2 hogs heads of wine
12 fat sheep	1 bed with accessories
1 silver goblet	

The mania disappeared when some one worked out that the trait could be transferred by grafting.

Viruses are named after the host from which they were originally isolated.

For example Tobacco mosaic virus.

A virus doesn't have to include the name "Camellia" to be capable of infecting camellias

The only reported virus including the name camellia has, to date, been Camellia yellow mottle virus (CYMV).

Plakidas in 1954 demonstrated that the symptoms associated with Camellia yellow mottle disease were graft-transmissible. Therefore according to plant pathologists/virologists the disease must be associated with infection by a virus. Hence the name.



Symptoms  
associated with  
camellia  
yellow  
mottle



However, despite many attempts, no one has been able to definitively associate a virus particle/agent with Camellia Yellow Mottle disease.

In fact virologists no longer accept Camellia yellow mottle virus as a valid name.

Camellia yellow mottle is still a graft-transmissible disease.

## Viruses

**Nucleic acids (RNA or DNA)  
protected by a protein coat form distinctive  
particles and may cause disease.**

## Viroids

**Small naked, RNA molecules that cause  
disease in plants.**

**In citrus, viroids have been shown to induce different degrees of dwarfing in certain rootstock/scion combinations.**

**Combinations of different viroids have been used to modify tree growth and provide an economic advantage to crop production.**

**Although viruses and viroids are regarded as causing systemic infections, the distribution of viroids within the tree may be erratic.**



## In Camellias

Variegated flowers can be achieved by grafting onto particular root stocks

Virus or viroid is responsible

Camellias produce sports - erratic distribution of infectious agents??

Symptoms of yellow mottle may disappear  
- acute infection followed by chronic infection or chronic "activated" by infection with another agent

**There are a family of viroids – Apscaviroids - some of which are found in citrus.**

**We have detected several different apscaviroids in camellias**

**Apple fruit crinkle viroid**

**Australian grapevine viroid**

**Persimmon viroid 2**

**There are others members of the apscaviroid family who might also be present.**

# Apscaviroids

<b>Apple scar skin viroid (ASSVd)</b>	<b>Citrus bent leaf viroid (CBLVd)</b>
<b>Apple dimple fruit viroid (ADFVd)</b>	Citrus viroid 1
Dapple apple viroid	<b>Citrus dwarfing viroid (CDVd)</b>
Japanese pear fruit dimple viroid	Citrus viroid III
Pear rusty skin viroid	<b>Citrus viroid V (CVd-V)</b>
<u>Apple fruit crinkle viroid (AFCVd)</u>	<b>Citrus viroid VI (CVd-VI)</b>
<b>Australian grapevine viroid (AGVd)</b>	Citrus viroid original source
	Japanese citrus viroid 1
<b>Grapevine yellow speckle viroid 1 (GYSVd-1)</b>	
<b>Grapevine yellow speckle viroid 2 (GYSVd-2)</b>	
<u>Grapevine yellow speckle viroid 3 (GYSVd-3)</u>	
<b>Pear blister canker viroid (PCBVd)</b>	
<u>Persimmon latent viroid (PLVd)</u>	
<u>Persimmon viroid 2 (PVd-2)</u>	

Camellias contain high levels of polyphenolic compounds (tannins).

These interfere with many of the tests that we have available to detect viruses/viroids.

Used dodder to transfer viroids to a tobacco plant

Developed a method of extracting the RNA of viroids from camellias with a minimum amount of polyphenolic compounds.

Graft transmission studies using pure isolates of known viroids.

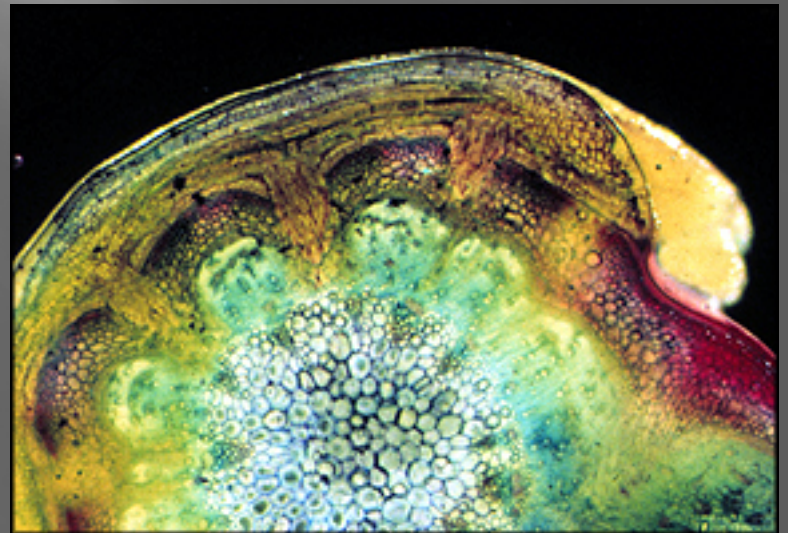
Developed probes specific for individual apscaviroids. Hope to use them to screen cultivars for presence of individual viroids.



**Dodder**  
***Cuscuta***  
**spp.**



**Dodder close up**



**Dodder haustoria**



A Mark Chason seedling chip-bud  
inoculated with a known isolate of  
Apple fruit crinkle viroid (AFCVd)  
almost 18 months ago.

No inoculated seedling





**Plan to screen variegated and non variegated forms of Camellia to determine which apscaviroids are present.**

**Examine the viroid content of rootstocks that are known to induce flower variegation.**

**Examine the distribution of viroids in camellias that show different variegation in different parts of the plant.**

**Determine if viroids are present in white-flowered camellias**

Some of the floral variegation may be genetically controlled



## Citrus leaf blotch virus aka Dweet mottle virus

Dweet tangor, is of Mediterranean Sweet orange and Dancy tangerine parentage. This synthetic tangor resulted from the breeding experiments of H. B. Frost of the University of California Citrus Research Center, Riverside. It was selected in 1930 and introduced in 1950.

Hulyn Smith told me that he was hoping to produce a camellia with dark green leaves and a highly variegated flower. He was using Vulcan



