Viruses Definition: A Case Study Guide About Life of Viruses

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Viruses Definition

Viruses definition were composed at different times by different workers. Its understanding can be depicted by the definition list. As we know that, viruses emerged as a new identity around 1930s.

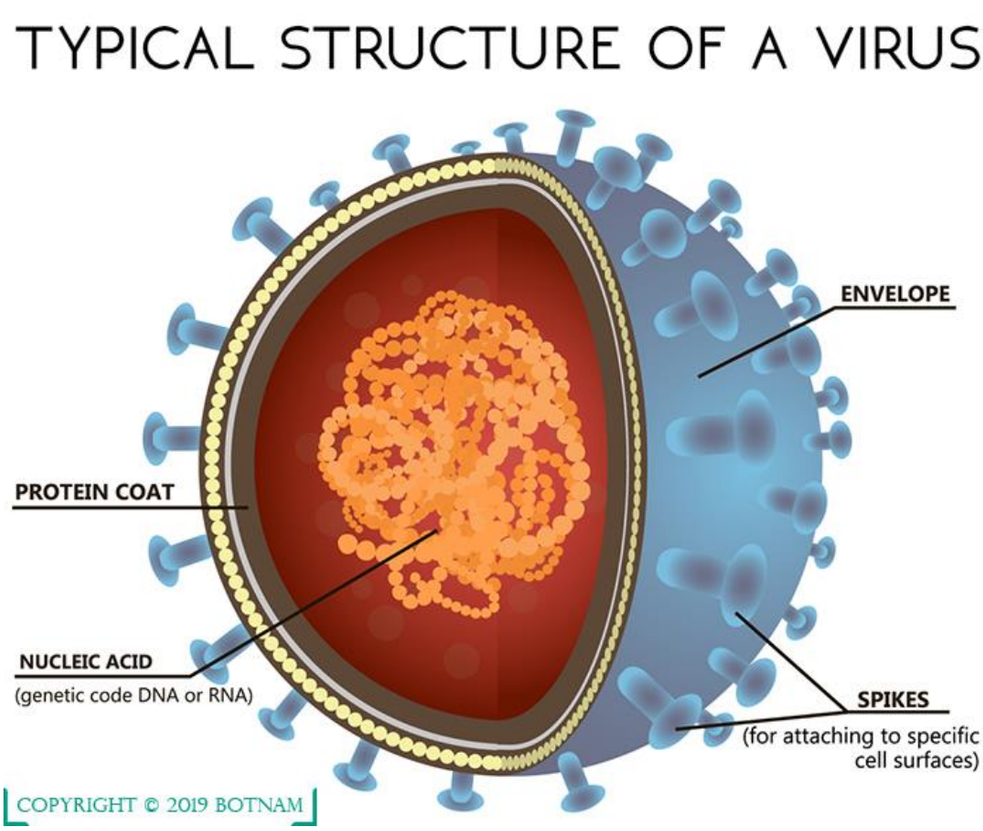
Viruses Definition by Different Scientists

Green (1935): According to Green's viruses definition ‘they are the smallest units showing the reproductive property considered typical life’.

Stanley (1938) says, "We are forced to conclude therefore, that although tobacco mosaic virus (T.M.V) protein has the ordinary properties of molecules, it also has the ability to reproduce and to, mutate properties not ordinary ascribed to molecules and hence that T.M.V protein represents are entity unfamiliar to us”.

Bawden (1943) said that, "virus is a pathogen which consists of at least one dimensions of less than 200 milimicrons – mu and in nature it is obligatory and parasitic)". This is the latest and most accepted viruses definition.

Virion Definition: Now a day the acceptable viruses definition says, they are obligate intracellular parasites and vary from 20-20 nm in size. They have varied shape and chemical composition but contain only RNA and DNA. The intact particle is termed a **"virion"** which consists of a capsid that may be enveloped further by a glycoprotein/lipid membrane and are resistant to antibiotics.



A Virus Structure

Structure of a Virus

The virus structure is of two types/nature described below:

Physical Nature

According to viruses definition, they are recognized as extremely small that cannot be seen through the highest magnification of the microscope using visible light. They are only recognizable by their biological behavior, such

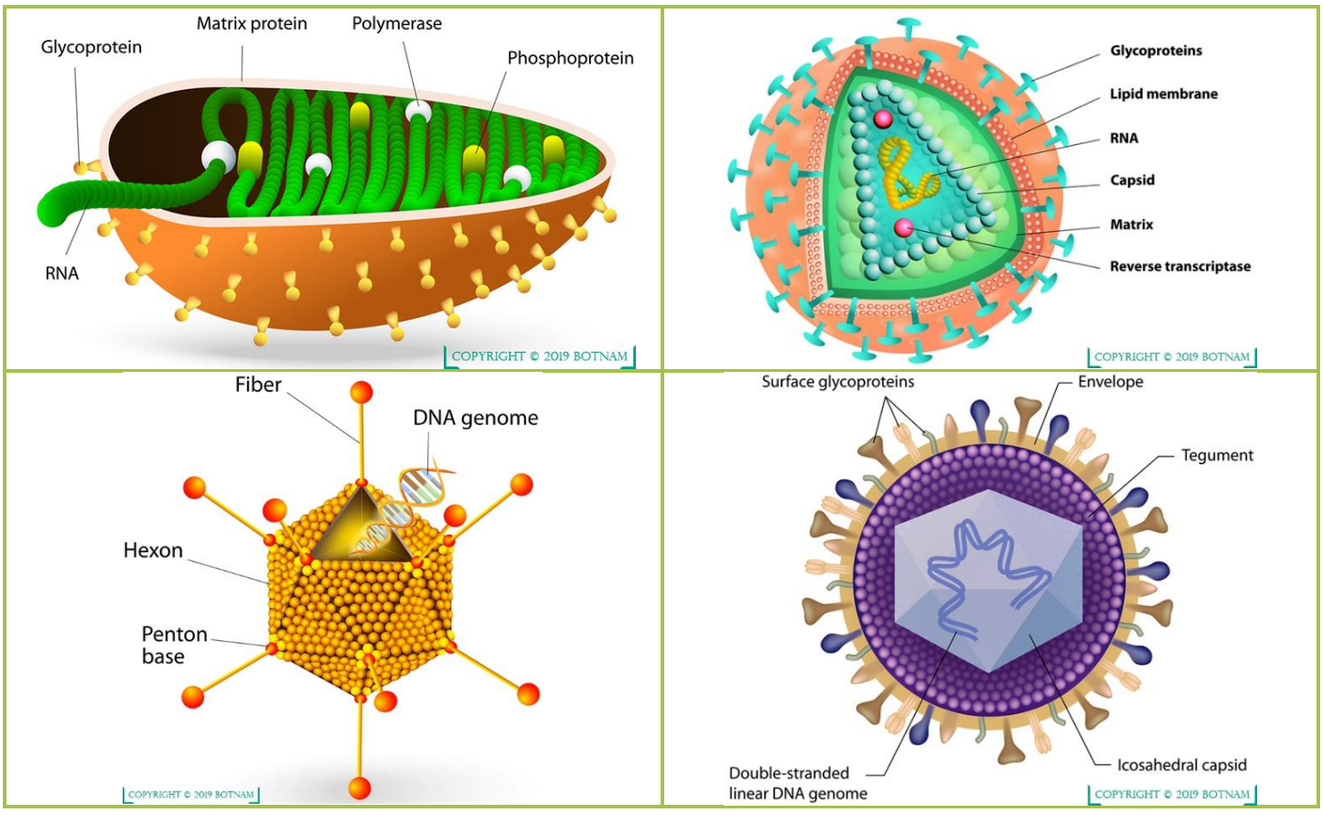
as the disease they cause. They were regarded as invisible form of bacteria, enzymes, toxins or as unusual products of metabolism of the cells in which they were found.

Chemical Nature

An American biochemist, Stanley in 1935. isolated a material by chemical means from the diseased tobacco leaves, which was appeared to be a protein of high molecular weight. By studying the founded material, Stanley observed that it incorporates all properties of tobacco mosaic virus.

Stanley on the basic of the chemical properties, identified the material as **autocatalytic protein**, which can multiply in living cell. Bawden purified the tobacco mosaic virus, and found it to be a crystalline nucleo-protein of very high molecular weight, retaining its infectiousness even when diluted to a concentration of 1/1,000,000.

This virus when examined with the recently developed electron microscope using X-rays was found to be in the form of bundles of rod-like protein. It must be virus itself because such nucleoprotein cannot be obtained from healthy plants. The study of potato virus confirmed this in 1938. Since then, protein of high molecular weight possessing all the properties of the respective viruses have been isolated and studied. Viruses have a core of **DNA** and a coat of protein in case the host is animal or bacterial while in case of plant virus the coat is made of protein but core is made of **RNA**.



Diagrammatic representation of four types of virus partials. **A**, Rabies virus; **B**, HIV; **C**, Adenovirus; **D**, Herpes simplex

Size of Viruses

Viruses are differentiated in size but many of them are rod-like and crystalline. **Tobacco mosaic virus** has a rod-like structure. Its length is 280*mμ* and the breadth is 18*mμ*. The tomato virus known as **'Bushy stunt' virus** has a diameter of 274*mμ* and 8,800,000-12,800,000 in molecular weight. Stanley studied the nucleo-proteins of the **'ring spot' virus** of tobacco. The virus with 19*mμ* diameter and molecular weight 3,400,000. The smallest plant virus known so far is **Tobacco 'necrosis ' virus**. It 13-20*mμ* in diameter and rounded in shape.

Classification of Viruses

The classification of viruses involves the use of wide range of characteristics, which includes three basic properties.

Virus Properties

a) Morphology which is further categorized into, size shape presence or absence and nature of peplomers, presence and absence of envelop, capsid symmetry and structure.

b) Physiochemical and physical properties which is further categorized into molecular mass, sedimentation coefficient, PH stability, thermal stability, cation stability, solvent stability, detergent stability, and irradiation stability etc.

c) Genome is further categorized into type of nucleic-acid, size of genome, linear or circular, number and size of segments, nucleotide sequence, presence of isomerization etc.

d) Proteins are further categorized into number, size and functional activities of structural and non-structural proteins. Amino acid sequence, glycoprotein etc.

e) Lipids are further categorized into contents and characters etc.

f) Carbohydrates are further categorized into contents and characters etc.

g) Genome organization and replication is further categorized into genome organization, strategy of replication, number and position of open reading frames, transcription characters, site of accumulation of virus proteins, site of virus assembly etc.

Anti-Genetic Properties

Serologic relationships, especially as obtained in reference centers.

Biological Properties

Natural hot range, mode of transmission in nature, vector relationship, distribution, pathogen city, association with disease, tissue tropism, pathology, histopathology etc.

Viruses Hierarchy

Based on these parameters' hierarchy developed for virus are given below.

Virus Orders

These represent groupings of families of virus that share common characteristics which make them distinct from other orders and families. Orders are distinguished by the suffix – verales. One order has been approved by the ICTV: **Mononegavirales**, which consists of the families **Paramyxoviridae**, **Rhabdoviridae** and **Filoviridae**.

Virus Families

These represent groupings of genera of viruses that share common characteristic and are distinct from the members of other families. Families are designated by the suffix —viridae.

Virus Genera

Virus genera are groupings of species of viruses Which share common characteristics and are distinct from the members of other genera. They are-designated by the suffix **virus**. e.g., Genera **Simplex virus** and **Varicello virus**. The criteria for designating genera vary from family to family, but include genetic structural and other differences.

Virus Species

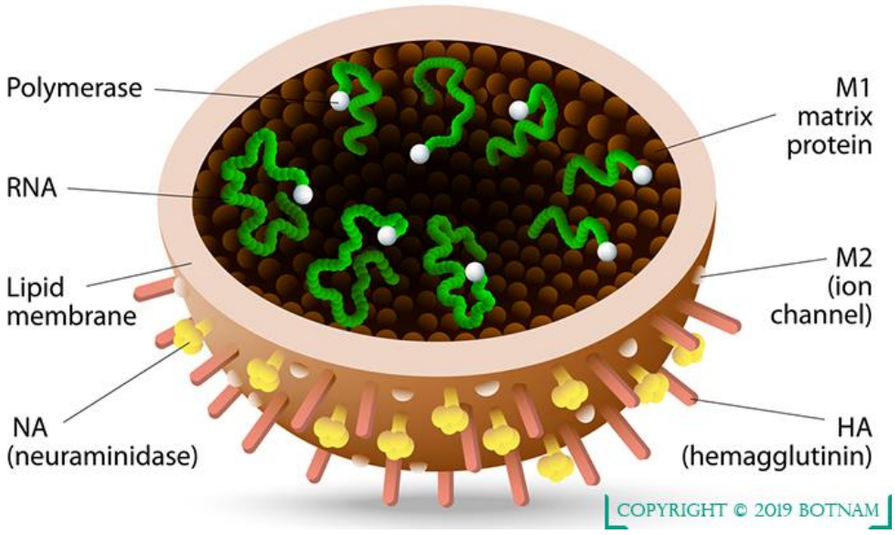
A virus species is defined as "a polythetic class of viruses that constitutes a replicating linage and occupies a particular ecological niche". Members of a polythetic class are defined by more than one property. At present the ICTV is examining the properties which can be included in determining species. The division between species and strains is a difficult one.

Grouping of Viruses - Types of Viruses

At present most of the virologists agreed that viruses are nucleo-proteins of high molecular weight. The coding capacity of viral genomes varies from <5 to >100 genes. Viral proteins are either structural, present as part of virion architect or non-structural, present only in infected cells. The limited number of virus proteins synthesized means that many of them are multi-functional. They have the power of multiplication when in some appropriate host. They are so restricted to the host that they are grouped according to their host. On this basis Viruses may be divided into three main groups, such as **Animal Viruses**, **Plant Viruses**, and **Bacterial Viruses**.

Animal Viruses

These are type of viruses who attack animals and causes diseases in them. Some important animal viruses are Influenza virus, Mumps, Pox virus, Reo virus etc. In structure Influenza virus differs from Tobacco Mosaic Virus (TMV) in that instead of being straight rigid particles, they are apparently more flexible and form loose coils. A further characteristic is that the DNA supercoils are enclosed in a protein envelop the outside surface of which is covered with minute protein particles probably involved in attaching the virus to the surface of host cells.



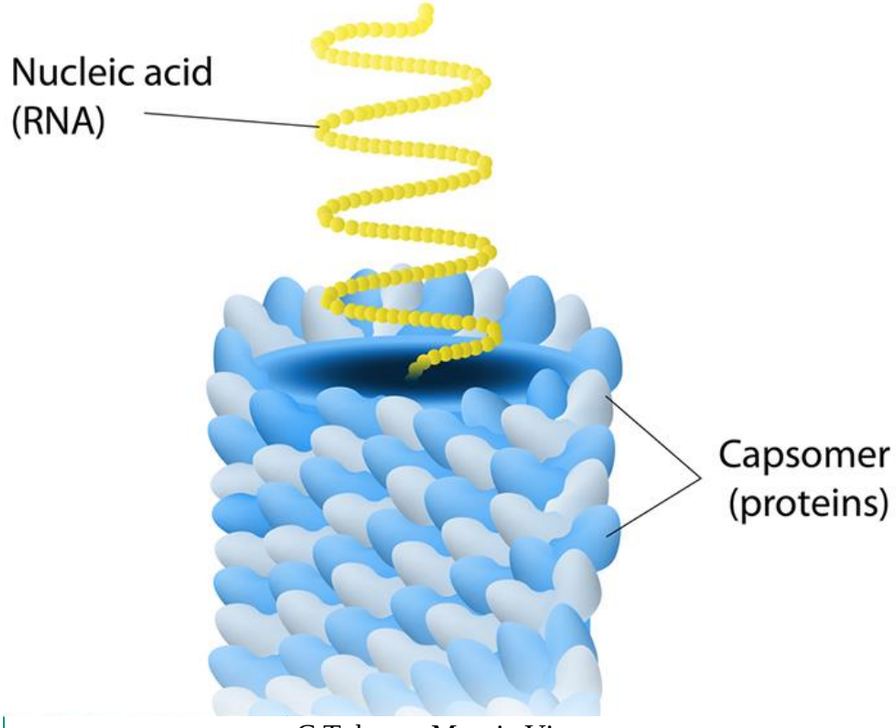
B Influenza Virus

Plant Viruses

There are over 1000 plant viruses which-have been classified by the ICTV. The virus usually receives its name by a combination of the host and the type of disease produced. Plant viruses are diverse in their morphology, nucleic acid composition and replicating patterns.

The list of important plant viruses includes; Turnip yellow mosaic, Tobacco mosaic virus, Tobacco satellite virus, Rugose mosaic virus.

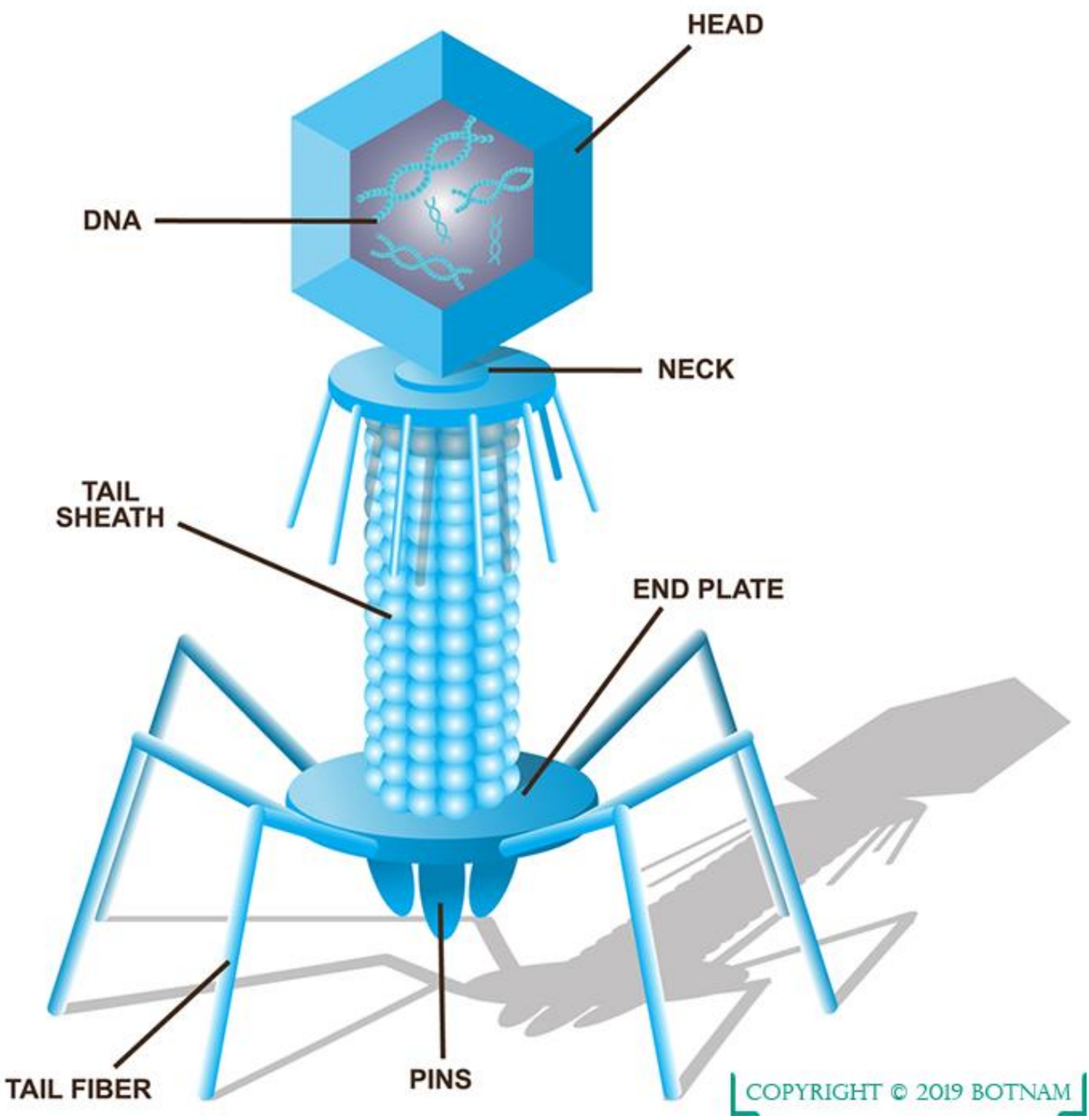
Generally, all crystallized plant viruses are composed of ribonucleoproteins. Here is an example of plant viruses.



C Tobacco Mosaic Virus

Bacterial Viruses

These are viruses which specifically attack bacteria. These bacterial viruses are also called as bacteriophages. Many scientists refer to these viruses as T4 bacteriophages. Now, the t4 bacteriophage have a complex shape and mechanism by which it attack the bacterial cell. Studies show that these viruses are like tadpole in morphology.



Symptoms of Viruses

Symptoms of viruses are in vast variety. Sometimes the same virus can cause widely different symptoms on different host plants, and the symptoms may sometimes be produced by a mixture of two or more viruses on the same plant. Thus, the viruses can be recognized easily by the symptoms they produce on the host. A few more common and easily detectable symptoms are given here:

Chlorosis in Plants

Due to the presence of viruses the chlorophyll of the green organs disappears at places, leaving yellowish spots, this is known as chlorosis, the presence of yellow spot at places, in the green tissue appears like a 'mosaic' pattern and therefore, the diseases with such symptoms. are known as 'mosaic' diseases.

Yellows

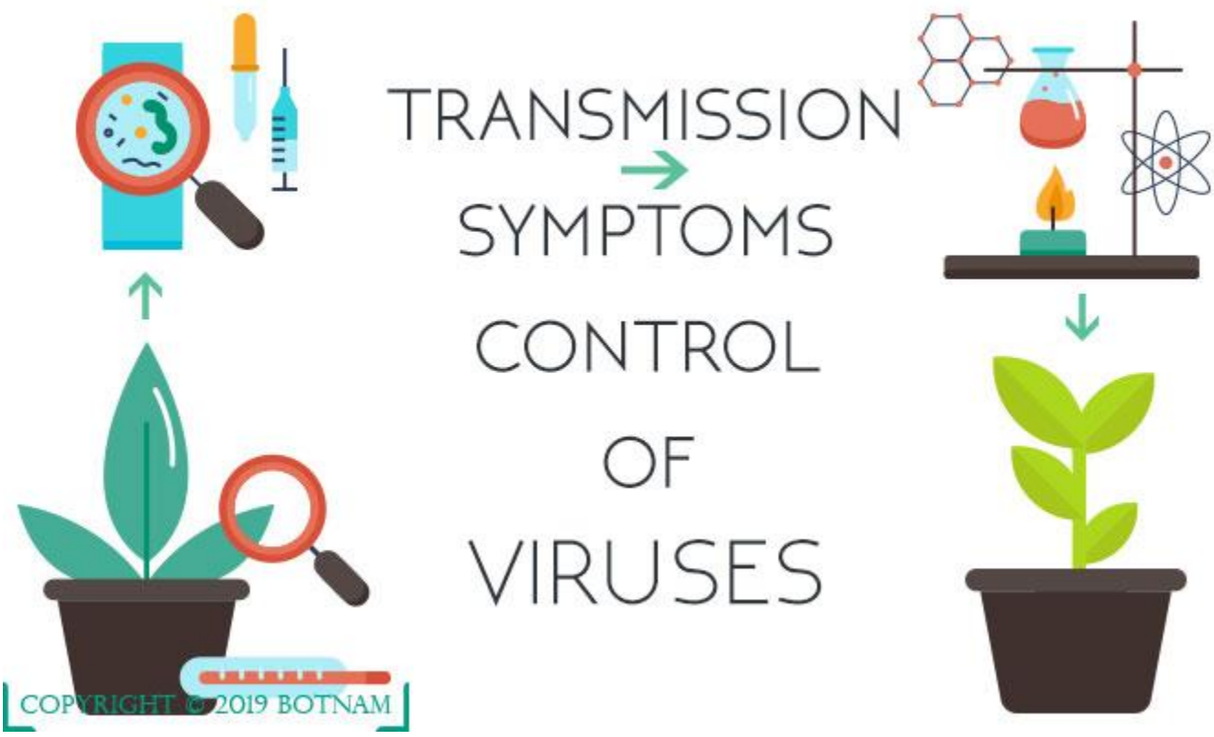
When the chlorophyll disappears completely from the host tissue, the organs turn yellow and the symptom is known as '**yellows**'. Mostly found in the leaves of plants, when they turn yellow. These are called yellow plants leaves.

Vein Clearing & Vein Banding

The disappearance of chlorophyll along the veins of the leaves is known as vein clearing and when chlorophyll surrounding the veins disappears the symptom is known as vein banding.

Necrosis in Plants

The brownish sports due to the death and ultimate drying of the tissue are known as necrotic spots and the phenomenon is known as necrosis. Necrotic spots are also known as lesions. Ring spots, bunchy top, galls hypertrophy, atrophy, rolling, curling, crinkling of leaves, stunting and dwarfing of plants are various other symptoms usually produced on the hosts by viruses.



Transmission of Viruses

Transmission of viruses is defined as the movement/transfer of the virus from infected plants to healthy ones by a number of agencies. These agents can be found in your surrounding area. The list is mentioned below.

By Grafting

A large number of plants are vegetative propagated. The most common method used in propagating fruit and ornamental plants is Grafting. When a virus infected plant is utilized for grafting with a healthy plant, the virus is transmitted through the cell solutions flowing from the infected part into the healthy parts.

By Seeds

Seed transmission of viruses is not common. Cucurbits and legumes viruses are transmitted by seeds. Their viruses are known as Mosaic Viruses. But in the crops, the viruses are transmitted by organs. Because crops are vegetatively propagated by the use of setts, tuber, rhizomes, bulbs, and corms etc.

By Contact

Due to contact or slight rubbing of the infected and healthy plant organs the viruses can be transmitted. Such transmission is quite easy in a thickly populated field where one plant is always in close contact. The organs can be rubbed with one another with the help of the slightest movement of the wind. Viruses usually gain entry through the injuries caused on the plant surfaces.

By Air & Water

The viruses are not easily transmitted by air and water unlike fungi and bacteria. The tobacco necrosis viruses have been observed to be transmitted by both air and water.

By Soil

The timing of TMV (Tobacco Mosaic Virus) is amazing. It lies dormant in the soil with the debris of plants after the crop harvest. When new seeds are sown in the same field where TMV is present. The virus infects the new grown crop. Thus, the cycle continues, if precautionary measures are not taken.

By Tolls & Agricultural Operations

The tools or hands of the field workers also gets effected/contaminated by the juice of infective plants during agriculture operations when the infected plant is cut or damaged i.e., pruning, weeding, irrigation or topping. Now, these tools and the hands of the worker transfer the viruses to the healthy plants, the contact with which cannot be avoided ordinarily.

By Store House

In store houses, where the infected leaves or any infected part of plant is stored. Healthy plants shouldn't be stored there. Because viruses such as TMV transfers from the infective plant or leaves of infective plant to the healthy ones.

By Insects

In nature viruses are ordinarily transmitted by aphids, jessed and white flies, which are the sucking insects. Most of the crop diseases viruses are transmitted by insects, and for this simple reason some virologists believe that there would have been no virus diseases if there were no insects. Several species of insects etc., can transfer the same virus.

Control of Plant Viruses

The easy methods of preventing disease spread and losses due to them are as follows:

Eradication

The destruction of infected plants and susceptible weeds, lessen the possibilities of the spread of disease.

Elimination of Insects

The use of insecticidal dusts and sprays reduces the chances of insect transmission.

Selection of Seeds

It should be made from such fields which were free from infection. Seeds of cucurbits and legumes, Setts of sugarcane, tubers, rhizomes and bulbs etc., should be carefully selected for seed purposes.

Tuber Indexing

It is done at the time of digging potatoes. Tubers taken from healthy plants are marked with ink and sown in small insect proof plots. The suspected diseased plants are removed carefully leaving only the healthy plants to grow. Thus, the healthy seed is multiplied.

Resistant Varieties

They are evolved at various research centers, and offer the best method for growing healthy crops.

Example of Viruses with Their Definitions

Below is the list of various viruses along with their definitions:

Oncogenic Viruses

A number of viruses are suspected of causing cancer in animals, including humans, and are frequently referred to as oncogenic viruses. Examples include human papillomaviruses, the Epstein-Barr virus, and the hepatitis B virus, all of which have genomes made up of DNA. (Source: Britannica)

RNA Viruses

An RNA virus is a virus that has RNA (ribonucleic acid) as its genetic material. This nucleic acid is usually single-stranded RNA (ssRNA) but may be double-stranded RNA (dsRNA). ... Another term for RNA viruses that explicitly excludes retroviruses is ribovirus. (Source: Wikipedia)

DNA Viruses

DNA viruses have DNA genomes that are replicated by either host or virally encoded DNA polymerases. There is considerable diversity among DNA virus genomes and the relative stability of DNA allows for genomes much larger than possible for RNA viruses. Genomes of DNA viruses that infect animals range in size from less than 2 kb of single-stranded DNA to over 375 kb of double-stranded DNA. There are even larger DNA viruses that infect eukaryotic microorganisms. (Source: ScienceDirect)

Enveloped Viruses

A virus that has an outer wrapping or envelope. This envelope comes from the infected cell, or host, in a process called "budding off." During the budding process, newly formed virus particles become "enveloped" or wrapped in an outer coat that is made from a small piece of the cell's plasma membrane. The envelope may play a role in helping a virus survive and infect other cells. (Source: Cancer.Gov)

Flu Virus (Influenza Virus)

Influenza is a viral infection caused by influenza virus or flu virus that attacks your respiratory system — your nose, throat and lungs. Influenza is commonly called the flu, but it's not the same as stomach "flu" viruses that cause diarrhea and vomiting. (Source: Mayoclinic)

Hepatitis C Virus

Hepatitis C virus (HCV), a member of the Hepacivirus C species, is a small (55–65 nm in size), enveloped, positive-sense single-stranded RNA virus of the family Flaviviridae. The hepatitis C virus is the cause of hepatitis C and some cancers such as liver cancer (hepatocellular carcinoma, abbreviated HCC) and lymphomas in humans. (Source: Wikipedia)

Enteric Viruses

Enteric viruses are the commonest causes of gastroenteritis worldwide, they are most often transmitted via the faecal-oral route, with transmission by direct human contact and via fomites being common. The infective dose can be very low. For example, a single rotavirus is capable of causing human infection. Some enteric viruses, notably noroviruses, are highly infectious and may be easily spread in aerosols and by contact with contaminated surfaces, sometimes resulting in large outbreaks of illness. (Source: Rapid Microbiology)

Complex Virus

Complex viruses are types of viruses which possess a capsid which is neither purely helical, nor purely icosahedral, and which may have extra structures such as protein tails or a **complex** outer wall. (Source: Bio Libre Texts)

Herpes Simplex Virus

The herpes simplex virus, also known as HSV, is an infection that causes herpes. Herpes can appear in various parts of the body, most commonly on the genitals or mouth. There are two types of the herpes simplex virus. **HSV-1:** Primarily causes oral herpes, and is generally responsible for cold sores and fever blisters around the mouth and on the face. **HSV-2:** Primarily causes genital herpes, and is generally responsible for genital herpes outbreaks. (Source: Health Line)

Human Viruses

These are type of viruses that causes disease or effect humans. Human viruses come in many types and have a wide range of effects. Some make us sick for a day or two before going away, while others are lifelong. Some are a minor annoyance, while others, such as HIV, can cause life-threatening problems. Here is a list of human viruses that might interest you.

Hydrophilic Viruses

Viruses that do not have a lipid envelope are called hydrophilic (water-loving) viruses. These viruses (such as polio virus, coxsackievirus) are more resistant to chemicals since they do not have the sensitive lipid layer on their outside. (Source: RDH)

Lytic Viruses

The bacteriophage have two cycles. The lytic cycle and lysogenic cycle. The viruses taking part in lytic cycle are considered as lytic viruses or lytic phages. These phages ultimately kill the host cell to produce many of their own progeny.

Negative Sense RNA Viruses

Negative strand RNA viruses are also known as an antisense-strand RNA viruses. A virus whose genetic information consists of a single strand of RNA that is the negative or antisense strand which does not encode mRNA (messenger RNA). Examples of negative-strand RNA viruses include influenza virus, measles viruses, and rabies virus. (Source: Medicine Net)

Positive Sense RNA Viruses

Positive strand RNA viruses are also known as a sense-strand RNA viruses. A virus whose genetic information consists of a single strand of RNA that is the positive (or sense) strand which encodes mRNA (messenger RNA) and protein. Replication in positive-strand RNA viruses is via a negative-strand intermediate. Examples of positive-strand RNA viruses include polio virus, Coxsackie virus, and echovirus. (Source: Medicine Net)

Teratogenic Viruses

Viruses that can be transmitted to the fetus and cause infection and tissue damage are called teratogenic viruses or teratogens. Five are known to be teratogenic viruses in humans: cytomegalovirus, rubella, herpes simplex, Venezuelan equine encephalitis, and varicella viruses. Other viruses which can infect and produce disease in the fetus are influenza, rubeola, Western equine encephalitis, variola, vaccinia, hepatitis B, echoviruses, and poliovirus. (Source: Link Springer)