#### Insect transmission of plant pathogenic viruses

- Plant viruses cause many and severe diseases of plants, their number and importance being second only to fungal diseases of plants.
- Most viruses infect their host plants systemically, that is, the virus multiplies internally throughout the plant.
- Almost all viruses enter and multiply in phloem and in parenchyma cells.
- Viruses do not produce spores, nor do they come to the surface of the plant.

#### Insect transmission of plant pathogenic viruses

- All plant viruses are transmitted to new plants that are propagated from infected plants vegetatively (that is, by grafting or budding, by cuttings, by bulbs, corms, roots, tubers, etc.)
- Many can be transmitted artificially by mechanical inoculation, that is, by rubbing sap from infected plants onto leaves of healthy plants.
- Some plant viruses can be transmitted from diseased to healthy plants by pollen or seed produced by infected plants, some by the parasitic higher plant dodder when it is infecting both virus-infected and healthy plants, and some plant viruses are transmitted from plant to plant by certain plant pathogenic fungi, nematodes, or certain mites.

#### Insect transmission of plant pathogenic viruses

- More than half of the plant viruses, numbering more than 400, are transmitted from diseased to healthy plants by insects.
- The number of insect groups that are vectors of plant viruses is relatively small.
- The most important vector groups, with the number of vector species and viruses transmitted, are;

### Hemiptera

Includes the

- Aphids (Aphididae, 192 species, 275 viruses),
- Leafhoppers (Cicadellidae, 49 species, 31 viruses),
- **Planthoppers** (Fulgoroidea, 28 species, 24 viruses)
- Whiteflies (Aleurodidae, 3 species, 43 viruses),









#### Hemiptera

- Mealybugs (Pseudococcidae, 19 species, 10 viruses)
- Some treehoppers (Membracidae, 1 species, 1 virus)





### Insect Vectors

- Thrips (Thysanoptera, 10 species, 11 viruses)
- Beetles (Coleoptera, 60 species, 42 viruses)
- Grasshoppers (Orthoptera, 27 species)
  - seem to occasionally carry and transmit a few viruses.
- Unquestionably, the most important virus vectors are the aphids, leafhoppers, whiteflies, and thrips.
- These and the other groups of Hemiptera have **piercing and sucking** mouthparts, although several thrips have rasping, sucking ones.

#### Insect vectors

- Beetles and grasshoppers have chewing mouthparts, but many beetles are quite effective vectors of certain viruses.
- Generally, viruses transmitted by one type of vector are not transmitted by any other type of vector.

## Aphids and aphid-transmitted viruses

- Aphids have evolved as the most successful exploiters of plants as a food source, particularly in the temperate regions.
- Many species of aphids alternate between a primary and a secondary host, although there are many variations of aphid life cycles depending on the aphid species and on climate.
- Some aphids overwinter as parthenogenetic viviparous forms while others go through their life cycle on one host species or on several related species.

## Aphid

- On the other hand, there are several aphid species, such as *Myzus persicae*, that have as many as 50 primary and alternate species of host plants.
- Aphids have mouthparts that consist of two pairs of flexible stylets held within a groove of the labium



# Aphid feeding

- During feeding, the stylets are extended from the labium and, through a drop of gelling saliva, the stylets rapidly penetrate the epidermis.
- Penetration may stop at the epidermis or it may continue into the middle layers of leaf cells with a sheath of saliva forming around the stylets.



# Aphid feeding

- The stylets move between the cells until they reach and enter a phloem sieve tube from which the aphids obtain their food.
- Individual aphids vary in their ability to transmit the virus to individual plants.
- Infection of a plant with a virus often makes the plant more attractive for aphids to grow on and to reproduce.
- Both acquisition and transmission of virus by aphids are affected by temperature, humidity and light.

