

VIRUSES by Michael Harrison.

At the October meeting last year, Mike Harrison, A.N.O.S. Sydney Group's Research Officer presented a report on viruses and virus infection, as commissioned by the Committee. The following article is his report, now published for the information of all members.

Viruses are a group of minute infectious agents characterised by a lack of independent metabolism, and the ability to replicate only within the living cells of the host organism. As such they are obligate parasites.

There has been some debate about whether viruses should be considered as truly living organisms. On one hand they are constructed of organised organic compounds, and they are able to multiply with genetic continuity (hereditary characteristics are transmitted by nucleic acids) with the possibility of mutation.

On the other hand however, once viruses are removed from their host, they are entirely inert and exhibit none of the characteristics usually attributed to the living state. Even within their host, they do not carry on respiration or synthesise any materials for energy and growth. Even multiplication, which can occur only within host cells, differs from reproduction in other organisms. The virus particles do not grow and divide, and particles do not arise from pre-existing particles.

Viruses are composed of a protein sheath surrounding a core of nucleic acid, either DNA or RNA, which carries the genetic code of the virus (as in all organisms, the DNA or RNA carries the hereditary information).

Their method of replication is to invade a host cell and to convert the activities of that host cell to producing more virus particles. In effect, they switch the genetic code of the host cell, although it is not clearly understood how this mechanism works. In doing this, the host cell is destroyed and the newly formed virus particles are released to invade surrounding host cells.

Viruses are extremely small in size and are invisible even under the most powerful light microscopes. An electron microscope is used to study them.

In shape they may be oval, spherical, polyhedral (with numerous facets), rigid rods or flexible threads. They are not given scientific names as such like truly living organisms, and are named after their main host or the disease symptoms produced. Viruses are generally separated into 3 subgroups - bacterial viruses, plant viruses and animal viruses.

Animal Viruses

Many infectious diseases of humans and other animals are caused by viruses, from common childhood diseases like chicken pox, measles and mumps, through to the common cold, influenza, herpes, warts, viral pneumonia, Poliomyelitis, to the real nasties such as Yellow Fever, Rabies, Small Pox, AIDS (HIV virus) and Marburg's Disease (a highly fatal haemorrhagic fever caused by the Ebola Virus).

Most viruses are highly infectious and are readily transmitted from diseased to healthy hosts by various means. Many are spread by direct contact or by droplets in the air. Mosquitoes and ticks are also common transmitters.

We control virus infection by:

- Natural species or race immunity (not affected at all or mildly affected).
- Developed immunity due to previous exposure and subsequent production of antibodies.
- Immunisation by a specific vaccine (a suspension of killed or altered micro organisms administered to produce antibodies)
- Antibodies attack and neutralise viruses by isolating, and/or metabolising them.

Plant Viruses

Over 400 plant viruses have been identified. Among economically important plants affected by virus are potatoes, tomatoes, sugar cane, corn, wheat, peaches, beans, rice, cucumbers, strawberries, raspberries, apples and many ornamentals including of course ... orchids.

Viral diseases are generally most serious in plants that are vegetatively propagated by man. Virus may kill localised areas, entire plants, or most commonly, reduce plant vigour and thus yield.

Methods of plant virus transmission are numerous, including direct contact, sap drip and insect vectors such as aphids, white fly, mealy bugs and grasshoppers.

In cultivation the most common form of transmission is sap transfer from an infected plant by cutting tools, which occurs commonly during grafting, pruning and cutting flowers. Mechanical and insect transmission may also occur.

The mosaic group of viruses is important: the effect they produce is a mottled or irregular patchwork appearance caused by chlorophyll destruction. Foliage may also be wrinkled. Another symptom is colour-breaking in flowers especially in gladioli, pansies and wallflowers. This response however is best known in tulips, which feature contrasting colours. Many have been in cultivation for years and show no signs of cumulative weakening. In bygone days some strains attracted high prices.

Virus in Orchids

A number of viruses are known to infect orchids. For many years growers have been aware of Tobacco, Mosaic Virus, Cymbidium Mosaic Virus, Cymbidium Necrotic Ringspot Virus and Odontoglossum Ringspot Virus. In recent times a new group of viruses known as Rhabdovirus, has been identified in collections in Australia.

In a series of articles in some of the orchid journals including, "The Orchadian", over the past 18 months or so, Don Gowanlock of University of Queensland has detailed the symptoms associated with these "new" viruses. They are excellent articles, and all growers should read them and take note of the pictures.

However, for the average grower, precise identification is not really important. All we really need to do is recognise the symptoms of virus infection generally, and take steps to prevent its spread.

The presence of virus in orchids disrupts normal growth, and may cause weakness, distortion and malformation. The effects are especially noticeable in stressed plants. Leaf symptoms include irregular chlorotic or mosaic patterns, necrotic streaks and spots, often in circular or mosaic patterns and erosion of the leaf surface. Other symptoms include reduction and/or distortion of stems, leaves and inflorescences, colour-break in flowers and bud drop. Plants weakened by virus are also more susceptible to attack from other diseases and pests.

In the collections of most growers, it will be leaf symptoms that will indicate the presence of virus. While leaf symptoms are many and varied, and may be quite different from genus to genus, the main differential diagnostic features are the more or less circular arrangement of the necrotic spots, and the presence of chlorotic areas, usually in association with the necrotic spots and patterns. Chlorosis is an absence or reduced amount of chlorophyll, giving a yellow or bleached appearance.

Even plants with no apparent symptoms may be infected, with good culture masking the effects, but eventually the signs will show through.

As with other plants, sap transmission will carry virus from an infected orchid to a non-infected orchid. This commonly happens with cutting implements such as scissors, secateurs, knives and the like. Plant leaves rubbing together or even just touching, on the nursery bench, during transport or at shows may also transmit virus. Touching your plants, especially running your fingers along the leaves as many growers do to kill aphids, may also transmit virus. Pollen transfer is also known to result in virus transmission.

Virus particles are very small and can enter through the tiniest of wounds on a plant, wounds that may be quite invisible to the naked eye. After mechanical transmission, which is essentially the result of cultural techniques and practices, the next main method of virus transmission is by sucking and chewing (, insects. Aphids in particular are known carriers of virus, and other suspects must include thrips, mealy bugs, Grasshoppers, beetles (especially the Dendrobium Beetle) and scale insects.

Treatment

You cannot do anything about a plant once it is infected with virus. There is no treatment and no cure, so you must at least isolate an infected plant from non-infected plants, and preferably destroy it by burning it.

Do not put it in the bin, or take it to the tip, as someone will pick it up and take it home with them, thereby perpetuating the problem. Remember also that all parts of the plant will be infected, and divisions and aerals will carry and perpetuate the virus. Even meristem propagations (ie mericlones) will usually be infected.

Plants can be tested for virus if they are valuable, but even if you only suspect the presence of virus, you must isolate those plants until they can be checked. There are commercial laboratories where this testing can be done at reasonable rates.

It sounds hard to say it, but you really **MUST DESTROY** infected plants. While they remain in your collection they are a potential source of further infection, and you run a real danger of contaminating, non-infected plants, not only your own but other people's as well if you take your plants to meetings and shows.

Control

Do not use any cutting instruments from plant to plant without sterilising such instruments in between - by flame or boiling, by alcohol, or by soaking in a saturated solution of Trisodium Phosphate. This means any cutting of plants, including rhizomes, stems, leaves, inflorescences and flowers.

Do not unnecessarily touch or handle your plants, and especially keep your hands off other people's plants at meetings and shows.

When working on your plants (repotting, potting-on, grooming etc.) keep your work surfaces clean and use fresh sheets of newspaper between each plant. When you have finished with a particular plant, wrap up all plant debris, old potting material, pots, stakes and the like in the newspaper sheets you have been working on, and dispose of the package. Then wash and dry your hands, lay out fresh sheets of newspaper, and start on the next plant.

This may seem like an elaborate and time-consuming procedure but it is simply a habit you must get into, and it will certainly be worth it in the long run.

Do not re-use pots and potting mixes, stakes, ties or anything else that has been in contact with your plants. The big advantage of using plastic pots is that they are cheap. so you don't have to re-use them.

Do not introduce new plants directly into your collection. Keep them segregated and under observation, especially adult plants and divisions, until you are satisfied that they are clean. Likewise, do not give away, swap or sell any plant, division or aerial growth that is infected or shows any suspicious signs.

Do not allow a build-up of insect Pests within your orchid house(s). An effective insect eradication program is an important part of creating and maintaining a virus-free collection. As soon as you see something that needs attention treat it immediately. General orchid house hygiene will assist greatly in this area.

Conclusion

To maintain a virus-free collection, you must adhere to guidelines detailed above. Even if your plants appear to be free of virus-like symptoms and you believe them to be uninfected, still follow the procedures. In this way you will completely rule out the possibility of transmitting virus through your collection. In the past couple of years there has been a considerable amount of research done on viruses in orchids, and growers should be aware of the signs and symptoms. Contrary to popular belief, native orchids are not somehow less susceptible to virus infection, and native orchid growers cannot afford to be complacent.

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Update

A couple of weeks ago I rang Don Gowanlock and spoke to him about sterilisation methods for the cutting implements we use on our orchids. These methods include flaming, boiling, alcohol, trisodium phosphate and sodium hypochlorite (bleach).

Based on his investigations and experience. Don made a number of important points:

Prior to any form of sterilisation, your cutting blades should be washed or wiped completely clean of any plant debris and sap. Only after this step has been taken. will the sterilisation techniques outlined below be effective.

Sterilisation by trisodium phosphate is the preferred method. This involves making up a saturated solution of this compound (dissolving it in warm water to the point where no more will be taken into solution, and undissolving crystals of TSP remain visible in the bottom of the container), and then soaking your cutting implements for 10 minutes. After you remove them, they should be rinsed in clean water to remove any residual trisodium phosphate solution.

Flaming is effective only if it is hot enough and for long enough. A gas burner is the best thing to use (cigarette lighters are completely ineffective) and the cutting blades should be brought to the point where they begin to glow.

Sterilisation by 70% alcohol is effective (indeed 70% is more effective than 100%) as long as enough time is allowed. The alcohol should be in contact with the cutting blades for 10 minutes.

Sodium hypochlorite (bleach) is probably effective, but longer soaking time should be allowed. As with trisodium phosphate, your implements should be rinsed with clean water after soaking.

Don also told me that one of the honours students at the University of Queensland is currently doing his thesis on sterilisation techniques. The results of this work should be available within the next 12 months.