Viruses infecting Brassicas

Turnip mosaic virus

Turnip mosaic virus (TuMV) is a positive-sense single stranded RNA virus of the family *Potyviridae*. The virus causes disease in brassicas and other economically important vegetable, oilseed, forage and ornamental crops. A wide range of weed hosts exist for TuMV, including turnip weed, bittercress, sow thistle and sheppard's purse, which may or may not show symptoms of the disease. The virus is spread non-persistently by a wide range of aphid species, but most common in cropping areas it's the green peach (*Myzus persicae*) and cabbage aphids (*Brevicoryne brassicae*). Non-persistent virus spread is very quick, aphids only need to feed for less than a minute to pick up the virus and a similar feeding time to deposit the virus into another plant. Once the virus is deposited into another plant the aphid is unable to spread the virus further, unless it feeds again on an infected plant. TuMV is not seed-borne.

Symptoms

Symptoms depend on virus strain, host plant and environmental conditions, but can include necrotic spotting and mosaic with leaf distortion and yellowing, particularly on the outer leaves. Necrotic spotting often occurs several layers deep within cabbage heads, with the outer layers appearing normal. The virus causes stunting and dieback in plants, which may lead to dwarfing, head collapse and early senescence. Cabbage can develop internal necrosis post-harvest, rendering the heads unsaleable.

Economic impact

Infections often occur with TuMV and other viruses, including *turnip yellows virus* (TuYV), *cauliflower mosaic virus* (CaMV), and *beet western yellows virus* (BWYV). These multiple infections often exacerbate symptoms. Crop yield and quality is severely affected by these viruses. Growers in the Lockyer Valley in Queensland have reported up to a 70% reduction in marketability of Chinese cabbage and other crops affected by TuMV and TuYV.

Multiple infection of CaMV, TuMV and TuYV in Iceberg lettuce (left), Chinese cabbage (middle) and Cos lettuce (right)

Turnip yellows virus

First reported in Australia in the 1980s, TuYV has now been detected in NSW, QLD and WA, with a diversity of isolates already identified. TuYV is a phloem limited polerovirus virus also spread by numerous species of aphids, but in a persistent manner. Persistent virus spread takes much longer than non-persistent virus spread. For persistent virus spread, an aphid needs to feed for several hours to pick up the virus after which the virus circulates within the aphid's body to the salivary gland. This can take up to 12 hours. Once in the salivary gland it can be deposited into another plant. The aphid can then continue to spread the virus for weeks, or the rest of its life. The virus is also not seed-borne.

Similar to TuMV, TuYV has a wide range of crop hosts, and is found in many weeds. Virus symptoms are similar to those of TuMV, including interveinal yellowing, leaf distortion, and plant stunting.

Cauliflower mosaic virus

CaMV, of the genus *Caulimoviridae*, predominantly infects brassica crops and weeds, such as wild radish, as well as some members of the *Solanaceae* family. CaMV was first detected in Australia in the 1980s. During the last 12 months, disease surveys in South East QLD have detected CaMV in coinfections with TuMV and TuYV in wombok, daikon, broccoli and various weed species, including bittercress, burmetic, sow thistle, and turnip weed. Symptoms of CaMV infection are similar to the other viruses, and may include mosaic, necrotic lesions and plant stunting. Previous studies indicate that the economic impacts of CaMV may be less severe than those of TuMV, however, the effects on quality and yield are likely to be compounded when two or more of these viruses are present

Virus identification

Although there may be some differences in disease symptoms induced by the different viruses, it is very difficult to use these as a tool to identify which virus is present within the crop. All three viruses mentioned here have symptom ranges which overlap to some degree with each other and it's highly likely there could be more than one virus present which can also confuse symptom ranges. Conversely, absence of symptoms doesn't mean absence of virus. Both TuYV and TuMV were detected from apparently healthy kale crops in South East QLD. Laboratory assays are needed to identify which virus or viruses are present.

Chinese radish (Daikon) showing symptoms of virus infection. Plants sampled and tested with these symptoms almost always had TuMV and CaMV. Some but not all also had TuYV.

Management strategies for TuMV and TuYV are challenging due to their wide host range and spread by multiple aphid species. The viruses and their aphid vectors survive in the non-planting season largely through the presence of weed hosts. Where possible control of weed growth, particularly close to crops is recommended. Monitoring seasonal movements of aphids can help with improving knowledge on when these viruses are likely to be of concern.

Use and select insecticides with caution. None are registered for control of virus diseases as mostly they have no useful effect in preventing in-crop spread of these viruses by the aphids. Targeted applications of systemic herbicide or insecticide on weedy areas could help prevent virus being introduced into crops by migrating aphids, although green peach aphids tend to exhibit very high levels of resistance to many insecticide chemistries. Implementation of IPM strategies utilising beneficial insects, such as parasitoid releases may be effective in reducing overall aphid populations in the district. Several parasitoids are available, which target aphids, such as *Aphidus colemani*, which attacks green peach aphid, cotton aphid, turnip aphid, and oat aphid.

Avoiding planting highly susceptible varieties when aphids are present is an effective strategy for managing these diseases in the field, as is the use of resistant lines where available. Overseas, efforts are underway to develop TuMV resistance in a variety of vegetable crops, specifically in Chinese cabbage, but also in white cabbage, radish, and lettuce.

Direct use of insecticides within crops is not recommended, particularly for non-persistently spread viruses. It can have the reverse effect and cause aphids to feed more rapidly, and hence spread the virus faster. It could have some benefits for persistently spread viruses, however, this is not well understood. The potential impacts on increasing insecticide resistance within insect pest populations should also be considered.

Future research

Greater knowledge of the distribution and genetic makeup of viruses affecting Brassicas throughout Australia will contribute to the success of local management strategies, particularly in building breeding initiatives for increased resistance to local virus strains. This will continue to be investigated in Hort Innovation Project VG16086: Area wide management of vegetables diseases, viruses and bacteria.

Further information

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