

## RECOGNIZING VIRUS SYMPTOMS IN VEGETABLE CROPS

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Virus problems are not new to vegetable production. When you read through the literature, you will find references to many economically important virus incited diseases. Often these viruses are yield and quality limiting and in some instances they threaten the sustained production of certain vegetables in areas where losses to specific viruses pose yearly threats to the local growers. In the Midwest, we observe some virus-infected plants every year in fields of peas, snap beans, potatoes, cucurbits, peppers, and tomatoes. The virus incited problems we face are usually aphid-borne and in most cases, the spread we observe is quite localized. Up to a few short years ago, losses were generally relegated to a few plants on the field margins where infective aphids moved in from field margins where they fed briefly on weed hosts of the virus, moved to production fields where they probed a few plants and then either continued to feed and multiply or simply moved on in search of more appealing plants.

We've experienced our share of virus problems over the years. Some may recall severe virus problems on peas about a decade ago on fields in south-central Wisconsin. We observed diagnostic symptoms of viruses resembling pea mosaic, red clover vein mosaic, pea streak and pea enation mosaic virus either alone or in mixed infections on the same plants. Virus symptoms were observed on almost every plant in a large number of fields. Yields in some of the fields with the highest incidence were often less than 100 lb/acre and several fields were disked prior to harvest. Warm dry conditions during the spring and early summer coupled with early harvest of hay and maturation of grasses led to an early season buildup and movement of aphids into production fields. Other virus-related problems we have observed in recent years include outbreaks of zucchini yellow mosaic virus on zucchini squash and difficulty in controlling aphid transmitted viruses such as Potato Virus Y on certain susceptible potato cultivars.

The virus problems we've experienced in the past years pale in comparison with the situation field personnel began noticing in 2000 on snap beans. Initially symptoms of virus infection were observed in the Cambria area of south-central Wisconsin and a band stretching along the western edge of Lake Michigan from Milwaukee north to Manitowoc. A high percentage of the plants within each of many fields exhibited symptoms of virus infection. The appearance of virus symptoms has continued during each subsequent year with accompanying losses in production fields. In each of these years, symptoms appeared on snap beans approximately 2-3 weeks after populations of soybean aphids took flight, leaving their host soybean plants and moving across the landscape in very high numbers. Subsequent studies on the viruses infecting

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symptomatic plants demonstrated the presence of at least three viruses including cucumber mosaic virus (CMV), alfalfa mosaic virus (AMV) and clover yellow vein mosaic (CYVM). By far, CMV was the most commonly observed virus on snap beans in Wisconsin. Observations in other Midwestern states, New York and Ontario, Canada concur with the Wisconsin studies. Symptoms of CMV infection have also been observed on other vegetable crops in Wisconsin including cucumber, squash, tomatoes and peppers. In many cases, there is a strong resemblance of symptoms caused by CMV and damage typically caused by drift of certain volatile herbicides. I'll attempt to review the key symptoms caused by CMV on several vegetable crops in the paragraphs below.

### Snap Beans

Plantings that reach the pin bean stage before mid-July may not exhibit virus related symptoms since aphid flights generally occur after this date. Later plantings, especially those flowering in mid-August seem to be the hardest hit.

Plants infected with CMV in the unifoliate or first trifoliate stage may be severely stunted, exhibit a downward curling of leaves and a mild to severe mosaic may appear on the new growth. Severely affected plants may die, but in some cases the plants may recover to produce somewhat normal leaves and a greatly reduced yield.

Leaf symptoms may include mild to severe mosaic on the foliage, dark green blisters with some blisters the size of a quarter, downward curling of leaves, leathery leaves, somewhat misshapen leaves, yellow flecking and in some cases severe yellowing of leaves. The later symptom is somewhat more typical of AMV and CYVM, but in association with CMV, symptoms can be much more pronounced.

Plant symptoms – In addition to the symptoms described on leaves, infected plants may be severely stunted, depending on the stage of growth when infected, and discolored. Compared with healthy plants, the number of blossoms may be significantly reduced and in some cases, the ground below infected plants may be covered with flowers that readily fall off before pin beans develop. Yields may be significantly reduced from expected levels.

Pod symptoms – Pods on infected plants may exhibit a faint mosaic pattern, external necrosis, internal purpling or browning and irregular shapes such as curling or twisting. Internal pod symptoms present severe problems to processors attempting to process a premium product since this symptom is not apparent until harvest and is virtually impossible to eliminate during processing.

### Cucurbits

Young plants may exhibit stunting, downward leaf curl, leaf crinkling, mild to severe mosaic patterns, yellowing of leaf veins and a reduction in leaf size. On older plants, symptoms are generally most severe and noticeable on the youngest leaves. Plants infected early in their development may be severely stunted with shortened internodes and reduced leaf size. Fruit on infected plants are generally bumpy, deformed and covered with light green to dark green mosaic patterns. Infected fruits may be bitter.

Cucumber breeders have incorporated CMV resistance into most cultivars. Thus knowledge of the cultivar in fields where symptoms are observed is critical in making a field diagnosis. It is possible that some cucumber cultivars may no longer carry the CMV resistance

gene and past resistance is not effective against current CMV strains. It is critical that symptomatic plants are collected for assay in fields of cucumbers where symptoms of suspected CMV are observed.

### Peppers

The severity of symptoms of CMV on pepper depend to a large degree on when infection takes place. Plants infected early in their development may be severely affected by mosaic, necrosis, tiny and deformed leaves and severe plant stunting. Plants infected later in their development may remain symptomless or exhibit only mild symptoms. In Wisconsin we've observed significant blossom drop with virtually no foliar or fruit symptoms.

### Tomatoes

Plants infected early in the season may appear yellow, bushy and stunted. Leaves may show a mottle or mosaic while in some cases, infected leaves may exhibit a shoestring-like leaf blade or severely malformed leaflets. It's not uncommon to see the shoestring symptom on older or younger leaves with the middle canopy having normal appearing leaves. Fruit on severely affected plants may be few in number, smaller than normal and delayed in maturity.

While the majority of losses to CMV in the Midwest are associated with snap bean production, we should remember that many other crops can be infected by this virus. In fact the CMV can infect 1,200 plant species in 101 plant families. This includes both monocot and dicot crops and weeds. Throw in a vector in overwhelming numbers at a time in the summer when crop plants are growing rapidly and are succulent attractions to viruliferous aphids and we have a perfect recipe for widespread virus losses on several important crops. It pays to be aware of CMV symptoms as you scout fields from mid-July through September, especially in fields with poor growth, weak appearing foliage, flower drop and poor yields. It is very possible that CMV is an overlooked problem on a number of vegetable crops.