Virus-induced diseases of greenhouse-grown flowers have the potential to be some of the most economically devastating diseases associated with the production of these crops, and some plant viruses can be more of a problem than others. Common viruses such as cucumber mosaic virus (CMV), tobacco mosaic virus (TMV) and tobacco ringspot virus (TRSV) can cause disease in floral crops, but they are relatively easy to control. In most cases, they result in little or no economic loss. Impatiens necrotic spot virus (INSV), on the other hand, is the most important virus associated with the production of greenhouse-grown flowers and herbaceous perennials. Unlike CMV, TMV and other viruses, INSV can cause serious economic damage to many different species and varieties of floral crops and perennials. The virus usually enters the greenhouse via infected plant material, such as propagation stock, or it can come in via thrips, its insect vector. Once in the greenhouse, thrips can spread the virus from plant to plant; if thrips populations are left unchecked, a virus epidemic will ensue. INSV can affect an entire crop and render it unsalable. This is particularly the case with impatiens, both regular and New Guinea types. Impatiens have, at best, very little or no resistance to INSV infection, so the best way to control the disease in impatiens is to prevent the initial infection. Knowing when a plant is infected at the earliest possible time is critical to successfully controlling this virus.

THE PROBLEM
One of the greatest challenges to plant health care professionals is the timely diagnosis and accurate identification of plant viruses that infect greenhouse-grown floral crops and perennials. Diagnosis is necessary so the grower and/or plant propagator can initiate the proper management strategies. If the diagnosis of infected material in the greenhouse is not timely, the virus can continue to spread and cause more damage. And if the identification of the virus is not accurate, the proper management strategies cannot be initiated for that particular virus. Management strategies will vary depending on the virus. It is the nature of some plant

If you’ve received a “false negative” while thrips or infected plant material spread INSV throughout your impatiens crop, The Ohio State University’s ongoing research to pinpoint virus movement and replication may help you improve diagnostic accuracy and stop infections before they start.

By Stephen G.P. Nameth
Diagnosis even more essential, since the con-
fungi and bacteria. This makes an accurate
ly associate with other pathogens, such as
or plant health professional could mistaken-
which appear to be symptoms that a grower
variety of symptoms in their hosts, many of
INSV and TSWV, however, induce a wide
accurate method of virus identification.
these symptoms can be used as a relatively
host, thus reducing their ability to be trans-
individual plant. The more samples taken from a
processors, stock plants are
infected plant will be infected with the same
stock, and every cutting taken from this
will continue to be a source of virus infection
for the entire greenhouse. Worse yet, the
grower may use this plant as propagation
stock, and every cutting taken from this
infected plant will be infected with the same
virus. For plant propagators, stock plants are
tested multiple times over many months in
an effort to approach 100 percent confidence
that the material they release is virus-free.
However, “false negatives” with INSV and
impatiens continue to be a problem.

A “false negative” result has the potential
to be very devastating because the grower
may be mistakenly assured that the subject
plant is virus-free. If allowed to remain in the
production facility, the “false negative” plant
will continue to be a source of virus infection
for the entire greenhouse. Worse yet, the
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To solve the “false negative” problem with
the INSV and impatiens pathogen/host sys-
tem, most university and private testing facil-
ities take multiple samples from the individ-
ual plant. The more samples taken from a
plant, the lower the likelihood of a “false neg-
ative” result. In most cases, the multiple sam-
ple procedure solves the problem for the test-
ing labs; however, it does not completely
eliminate the problem. In some situations, the
grower or propagator submitting the sample
may not be able to send the entire plant and
may only send enough tissue for one test.
Also, conducting multiple tests on every
plant can be very time consuming for the lab,
and it doubles the cost for the grower who
pays the lab on a per sample basis.

There are two possible solutions to this
problem. The first is to develop a test that is
sensitive enough to detect the presence of
the virus in plant tissue even if the virus concen-
tration is very low (a polymerase chain reac-
tion-based test [PCR] may work well in this
application). The second is to develop a
method or conditions that would guarantee
that the tissue sampled would have a virus
concentration high enough to be consistently
detected with ELISA.

PLANT VIRUS BACKGROUND

For many common plant viruses, much is
known about how they infect, how they multiply
and how they move throughout their host. Plant
viruses enter the plant cell via a wound or with
help from an insect vector. Once inside the cell,
the virus uses the biological mechanisms of the
cell to replicate (reproduce). Due to this infection,
the plant becomes “sick.” In most cases, the plant
doesn’t die because the virus needs a living host.
to carry out its life cycle. Once the virus has infected the host and has started to replicate, the virus begins to move from the original infected cell to a new cell, and the whole replication process starts again. This cell to cell movement continues until the virus reaches the host plant’s vascular tissue.

Once in the vascular tissue, the virus can move relatively quickly throughout the entire plant — this is termed a systemic movement or systemic infection. At this point, the plant reacts to this systemic infection by expressing symptoms. With INSV, however, symptoms vary greatly, with all symptoms indicating a systemic infection. The time it takes the virus to move throughout the entire plant and the eventual concentration it reaches in the infected tissue, depend on many factors, including temperature and light. Modifying the levels of light and temperature in which the host plant is growing can profoundly influence the virus’ progress, either slowing or increasing replication.

Most plant viruses eventually move systemically through the plant in a relatively even distribution and practically any tissue that is sampled will contain significant and detectable levels of the virus. With INSV and impatiens, the distribution and concentration of the virus in various parts of the plant can vary greatly. This complicates the testing process and results in the “false negative.”

THE SOLUTION

Research is being conducted at The Ohio State University that will hopefully shed a greater light on what INSV does once it is inside the plant. How the virus moves from cell to cell, which tissue is most likely to have a detectable concentration of INSV and what environmental conditions can enhance these factors are all questions that will be explored. Impatiens plants infected with INSV will be subjected to a variety of temperatures to determine the temperatures at which virus replication and movement is optimum.
The virus concentration will be monitored using the ELISA test; under our ideal conditions for virus replication, this widely used test will assure the industry that it is still applicable. INSV-infect ed impatiens will also be subjected to a variety of light intensities with the same end result in mind as with the temperature studies. We hope to determine a temperature and light regime that will allow for optimum test results.

HOW GROWERS AND PROPAGATORS STAND TO BENEFIT

Growers and impatiens producers will benefit from this research in that it will allow plant health professionals greater diagnostic accuracy and will greatly reduce the possibilities of “false negatives.” It will allow impatiens producers to subject plants that need to be screened for the presence of INSV to environmental conditions that will be optimum for virus replication and movement. This, in turn, will increase the accuracy of the test, and it will reduce the risk of virus-infected plant material being released to growers. It will also help reduce the cost of testing large numbers of samples.

Although this research will focus on INSV and impatiens, the conditions established for optimum virus replication may be applied to other viruses and other hosts, in particular TSWV and its wide list of hosts.

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Symptoms typical of INSV infection in regular impatiens (opposite top), cyclamen (opposite bottom), gloxinia (left) and dahlia (above).