the report and Donald Cation prepared a summary for the Proceedings.]

VIRUSES — THEIR IMPORTANCE TO THE PLANT PROPAGATOR

DONALD CATION
Michigan State University

Viruses are submicroscopic infectious entitites that multiply intracellularly and are potentially pathogenic. It is well known that viruses are extremely small, they get inside a plant by one means or another and multiply only inside living cells. Infectiousness means that they can spread, enter and reside within a plant. Pathogenic means disease producing, resulting in an abnormality that we can see or detect, such as lack of chlorophyll as seen in rings or mottles, dead spots in leaves, dead cells within the plant, reduced size or oversize of cells, excessive or reduced cell division or stunting of plants.

Viruses are only potetntially disease producing. They can infect a plant, increase in number and spread from cell to cell and may or may not cause disease in the process. Most of us are aware that viruses cause destructive or even mild diseases, but many are not aware that viruses can exist in certain plants without causing recognizable disease. In such cases the virus is said to be latent or hidden. It is these latent viruses that are of special concern, for a virus can be latent in one variety and be destructive to another.

A virus is not confined to a variety or species. Many of them infect plants in other genera, even in other families. We think of X disease of peach infecting stone fruits. Actually it can infect carrots, tomatoes, composites and widely unrelated hosts. Alfalfa dwarf is caused by the same virus the produces Pierce's disease of grape vines. The Green Ring Mottle virus of sour cherry is carried without symptoms in sweet cherries, apricots, plum and peach. Elm mosaic has been transmitted to peach with symptoms resembling peach rosette mosaic disease. Peach rosette was shown residing in red maple and recently Kirkpatrick in Wenatchee found tobacco mosaic in symptomless apple trees.

Some latent viruses are important to consider in disease control and others may be of small consequence. Cherry Yellows virus ruins a peach tree and also Italian Prune for productive purposes but it does not occur naturally on peach or Italian Prune in Michigan but does jump from cherry to peach in California causing the disease known as peach dwarf.

What about the increasing number of new viruses we hear about? Are they really new? This is hard to determine for viruses can mutate. But many are old viruses that are now recognized following more intense, directed observation. These old viruses may be new to a district or new to a crop. New varieties of plants are shipped around the world with the speed

of jets. New crops are grown intensively in the various countries. A new disease appeared on Cocoa in west Africa and threatened to ruin their industry. This virus disease, called Swollen Shoot, was found to spread from certain plants of the native vegetation. It was a new disease but not a new virus. The stem-pitting virus of apple has been demonstrated present in about 40 percent of the apple trees of the average orchard. It was only discovered when we started topworking the varieties Hyslop and Virginia Crab that happen to be susceptible to this virus. Discovery of the virus causation of stem pitting explained what in this instance was considered incompatibility.

Once inside a plant the virus can't get out and spread without help. Probably every virus that has been perpetuated has a vector, such as an insect helper that spreads it from plant to plant. A very few viruses are spread by pollen transmission and a few by seed. A few are spread under favorable conditions by rubbing juice from an infected plant to a healthy plant. The surest method of spread is by vegetatve propagation, such as division, cuttings or grafts. By this means the propagator can unwittingly spread latent or faintly perseptible but potentially destructive vriuses. I will cite a few examples.

Green ring mottle of sour cherry is symptomless on peach. It was known to be widely present and symptomless on sweet cherries but a survey of peach for this virus was neglected. I encountered this virus in peach 12 years ago when attempting to inoculate little peach virus into sour cherry. The cherry did not get little peach but all five inoculated trees showed the typical green ring mottle. I then inoculated back from cherry to peach to see if little peach and green ring mottle were caused by the same virus. They weren't. Meanwhile Dr. Fridlund of Prosser, Washington was indexing peach and other stone fruits for virus freedom and found green ring mottle well distributed as a latent virus in peach and apricot. He couldn't find a Sunhaven, Richhaven, or Rio Oso Gem peach free of this virus. We verified his findings and also found green ring mottle in one or two other new varieties considered for introduction through our peach breeding program. We are now indexing all introductions from our South Haven station.

Buds of Sunhaven and Richhaven have gone out from Michigan all over the world to peach growing areas. Perhaps green ring mottle has always had a world wide distribution but if it hadn't it has now. Stanley Johnston, our peach breeder, wrote to the leading fruit breeders of the U.S. and Canada asking if they were indexing their introductions for virus. None of them were.

Two years ago Dr. Mulder of Holland asked if I had Golden Delicious scions free of Rubber Wood virus. It appears that Golden Delicious scions first into Holland were grafted to a local tree to get a rapid increase. The local tree had rubber wood virus and all the Golden Delicious trees in Holland then carried that virus. We learn the hard way.

How can we circumvent the latent virus problem? In stone fruits we find some varieties that react visibly and clearly to several viruses. A minimum number of host plants to divulge all known stone fruit viruses consists of ten specific varieties. The host range originally suggested is Elberta, Montmorency. Bing, Napoleon, Lambert, Kwanzan, Shirofugan, Italian Prune. Shiro plum and Tilton apricot. Several substitutions and omissions have since been proposed.

There is an interregional stone fruit virus project known as IR 2, headed by Dr. Paul R. Fridlund at Prosser, Washington. The objective is to find and maintain virus-free clones of all fruit varieties. Every worker who had a clean variety sent it to Prosser where it was reindexed on the host range. Each variety that indexed free was established in an isolated location where it can't pick up viruses from outside sources. Scion wood from these elite, virus-free trees are distributed on request to experiment stations for further increase and eventual distribution to nurserymen.

If you get this wood make sure it goes on virus-free stock. Mahaleb, Mazzard and peach root stocks can carry ring spot and cherry yellows that transmit through the seed. Virus free certified seed and seedlings are becoming available.

We hope that apple certification will soon be perfected.

What can the propagator do about viruses? He should be alert and aware of the virus problem and propagate from virus-free stock when it is available.

BEN DAVIS: Is crown gall of peach caused by virus?

PROF' CATION: Crown gall is caused by a bacterium that can also live for some time in the soil, even in fallowed soil. It is controlled by dipping the seeds in calomel suspension before planting, by rotating with grain crops, etc.

BEN DAVIS: We had 50% gall in our peach. The following year a nematocide reduced gall remarkably.

PROF. CATION: This is noteworthy and should be followed experimentally.

JERRY VERKADE: Can viruses be combatted with chemicals or sprays?

DR. CATION: Outside of insect control in certain cases, no. Some success is obtained with certain viruses by treating with heat. This has given virus-free trees for increase.

MR. FILMORE: We are experiencing late summer defoliation of Kwanzan cherries and certain ornamental malus. A spray program was successful on the cherries but not on the malus. Where can plants be sent for indexing?

DR. CATION: I would suspect this is spray injury or apple scab rather than virus. Workers currently indexing for apple viruses are Dr. Gilmer, Geneva Station, N.Y.; Dr. Ralph Shay, Purdue Experiment Station, Lafayette, Indiana; Dr. Gaylord Mink, Irrigation Station, Prosser, Wash.; and Me at Michigan State University, East Lansing.

DR. REISCH: What is the potential for reinfecting disease-free stock?

DR. CATION: It varies with the vrius, the crop and the isolation. Sour cherries, with ¼ mile isolation from cherry yellows have remained free for 13 years. We hope to get a tree to full size and bearing before virus hits. A young tree with this virus is practically hopeless. For asters, another virus, aster yellows is prevalent in nearby weed hosts. Asters had to be grown under cloth to keep out insect vectors. Now we have resistant varieties. The same disease on head lettuce was reduced by spraying the edge of the field with parathion.

DR. MAHLSTEDE: Certain viruses can be eliminated by growing the plants under extreme heat. The tip of the plant is then excised and forced into growth, free of virus.

MR. NORDINE: Can you distinguish aphids, virus or other insect symptoms on leaves?

DR. CATION: Usually, yes. Occasionally this is difficult even for experts. Quince rust fungus on Delicious apples looks like aphid injury. Mineral excess or deficiencies may result in virus-like symptoms.

PRESIDENT ROLLER: Going now to Hans Hess for a report on the discussion of timing to take cuttings.

HOW CRITICAL IS TIMING IN TAKING CUTTINGS?

DR. F. O. LANPHEAR, *Moderator*
HANS HESS, *Recorder*

We had a very interesting discussion on how critical is the time of taking of cuttings. To begin with Dr. Lanphear from Purdue presented some general facts on a few of the difficult-to-root plants and the critical importance of timing in the taking of cuttings of these. Two examples that he gave were the umbrella pine — as you all recall Sidney Waxman a few meetings back told us about taking cuttings on certain time in late March to get good rooting. The time was very critical, a few weeks prior or a few weeks past the optimum time the rooting difference was terrific. Good rooting at the proper time and practically no rooting if it were too early or too late. Another thing that was mentioned by Dr. Lanphear were the deciduous azaleas which are very critical in the timing as far as taking cuttings to get successful rooting. Another example of timing and the use of supplemental lighting was brought out. The fact that Japanese yew cuttings taken in late winter and given supplemental light. The light promoted growth and the cuttings were actually retarded in rooting from those that were given no light. The conclusion here was that dormancy is beneficial for good rooting of Taxus.

Timing, it was brought out, must be determined for different species of plants. One member stated that he had faster