PLANT PATHOLOGY NOTE NO. 39

DISEASES OF CITRUS. PART 2: VIRAL DISEASES

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ABSTRACT

Field symptoms of five different virus diseases viz: psorosis, tristeza, exocortis, xyloporosis and vein enation-woody gall were detected during the virus diseases survey of citrus in Papua New Guinea. The four including tristeza, exocortis, xyloporosis and vein enation-woody gall are discussed.

INTRODUCTION

Citrus (*Citrus* spp.) including lemon, mandarin, orange, pummelo, grapefruit and lime is an introduced crop and was brought into Papua New Guinea in the late 1930s by the Germans and other missionaries. They were grown as a minor crop, mainly around and within mission and plantation establishments for family consumption. However, to satisfy the current demands of a rapidly increasing population, and to reduce the volume of imports, government has adopted import replacement policies by encouraging Papua New Guineans to cultivate the land and grow what can be grown including fruit, nut and vegetable. During the 1989 PNG's first international fruit and nut conference on substitution or replacement policies a resolution for the need to increase fruit and nut production in PNG was accepted. This need though has started - off very well there are still some associated problems.

A recent survey for virus diseases of citrus in PNG has indicated a significant increase in both the number of farmers and area under cultivation of commercial orchards. This has been due largely to the eagerness shown by farmers to grow citrus as an alternative cash crop as well as to learn the various techniques. As a result, two major problems have appeared including poor market infrastructure and pests and diseases. Diseased samples that appeared to have been infected by viruses were often suspected and not confirmed. Velsen and Philemon (1991) similarly detected 5 different virus-like symptoms in field orchards during the survey. These also need to be confirmed either by bological indexing or other appropriate methods.

This paper is intended to provide some useful information on the 5 virus diseases found during the survey. It will be used as an informative guide on what to look for in respect to virus diseases and how to look after or manage orchards properly by farmers.

Of the five virus diseases found, four are described here and recommendations are made for their control. The fifth virus of the *Psorosis* complex is also described separately.

TRISTEZA

Tristeza virus causes several diseases and among them "sad disease" or "quick decline" is by far the most common one causing death of sweet orange, mandarin and some other varieties on lime and sour orange rootstocks. It is transmitted by budding and grafting, dodder and insects. Insect vectors are mainly by aphids, viz: the black citrus aphid, *Toxoptera citricidus*, melon or cotton aphid *Aphis gossypii, A. spiraecola* and the green peach aphid *Myzus persicae*.

Symptoms

Appearance of trees infected by Tristeza virus is somewhat similar to that of trees in which roots have been injured or killed by fungus or damaged by waterlogging effect, excessive application of fertilizers, kerosene, smudge oil or plant regulators. The first noticeable symptom in the above ground parts is the changing of foliage colour from normal green to olive grey brown with a characteristic hardening in appearance. Leaves often curl upwards lengthwise and when new flush (new growth) after fall foliage is formed, it is usually sparse with obvious vein clearing. Fruits develop high colour more quickly and some may exhibit a lopsided distortion than fruits from normal or healthy trees. Underground symptoms often start first prior to any above ground signs become evident. The small fibrous roots around the root system die and their barks come off. Destruction and death of roots usually begins from the tips and gradually moves inward towards the main root and finally to the trunk of the tree. Generally when more roots become rotten the rate of deterioration at

the top becomes even more spectacular. This is usually characterised by the gradual changing in foliage colour, curling, wilting, dropping-off of leaves and dying-back of twigs. Severely affected trees often die as a result. Conditions such as low humidity and deficit in soil water favour the disease progress causing affected trees including young ones to collapse with a sudden wilting and drying of leaves.

Control

To avoid the spread of the Tristeza virus infection it is necessary to impose stricter quarantine laws against any introductions. This can be achieved in two ways. Firstly, introductions of propagative materials from abroad must be virus-free and from reputable sources which carry out virus testing and indexing programmes. Secondly, introductions within PNG either within the same province or province to province should be obtained only from orchards that are free from the Tristeza diseases. Owners of orchard nurseries either for use for themselves or for multiplication and distribution elsewhere must exercise strict hygiene procedures. Pruning, grafting and budding knives must be immersed (dipped) in 0.1% Sodium hypochlorite (1 g/ litre of water) and immediately into a detergent solution. Dish washing detergent will do a good job. The use of detergent is to avoid the metal becoming rusty.

EXOCORTIS

Exocortis or scaly butt is caused by citrus exocortis virus and is transmitted by using buds from infected trees. It mainly affects trees grafted or budded on *Poncirus trifoliata* rootstocks and to a lesser extent Rangpur lime, sweet lime and citrange. Buds from infected trees when worked on rootstock of other citrus species and varieties usually show no symptoms of infection yet still carry the virus, commonly known as symptomless carriers. Effects of this virus in such situations often appear when buds are taken from them and budded onto rootstocks of *P. trifoliata*.

Symptoms

Exocortis virus infection causes cracking and scaling of the bark on trunks. These symptoms are found mainly below the bud union. Scaling or pealing off of bark is often in vertical or straight strips. Affected trees are stunted and the trunks below bud union are much smaller in size than the portion above the bud union. These symptoms may be visible and become obvious only on trees more than 3 years old.

Control

Diseased plants should be removed and destroyed as soon as possible. Satisfactory control of the disease is obtained by using virus-free buds from non infected mature trees on *P. trifoliata* and citrange rootsocks. If any doubts index all citrus varieties by budding onto *P. trifoliata* rootstocks and observe tree reactions to the exocortis virus infection. Obtain buds only from healthy, mature trees already on those rootstocks with no signs of exocortis infection. To ensure no cross transmission (virus spread through the use of contaminated budding/grafting knives, usually during the budding process) of the virus budding knives must be immersed (dipped) in 0.1% sodium hypochlorite and into a detergent solution.

XYLOPOROSIS

Xyloporosis or Cachexia as it sometimes is known is usually transmitted through using infected buds from Xyloporosis infected trees. So far no reports of insect vectors (insects which carry virus particles in their mouthparts after sucking sap of infected tree and transmit the virus onto disease-free tree at their next feeding time) but there was earlier evidence that this virus was also transmitted through seeds, mainly through seeds of sweet lime and tangelo.

Symptoms

Diseased trees are generally characterised by the gumming and pitting symptoms of the stems. These symptoms are found mainly at the bud union and may extend for a half a meter from the bud union in older and severely infected trees. Affected trees are usually stunted and may defoliate (unusual but gradual leaf fall from trees) with leaves first becoming chlorotic (yellowish) along the midribs before falling.

The first symptom of disease on stems is the discolouration of the phloem or the inner bark due to gum exudation from tree in response to virus infection. On the surface of the wood a series of small brown gum lesions (spots) may develop at the bud union. In severely affected trees pitting of the wood becomes obvious and gumming may extend further away from the bud union. The inner bark surfaces will contain a clear semi-solid to solid gum impregnated protrusion which may fit into the depressions in the wood. In order to see all these stem symptoms the bark must be removed near the bud union.

VEIN ENATION-WOODY GALL

Vein enation virus is transmitted by budding using infected buds and by insect vectors: the black citrus aphid *Toxoptera citricidus* and the green peach aphid *Myzus persicae*. It causes two very distinct symptoms

on affected trees: small out-growths of veins on leaves and woody galling on branches and trunks and occasionally crown roots. The disease has been found on rough lemon, grapefruit, seville orange and acid lime.

Symptoms

On leaves enations (small outgrowths) develop underneath leaf surfaces, usually found on the main veins. The upper leaf surfaces may show a corresponding depressions. Infection on trunks, branches and collar (upper) roots results in the development of woody galls (abnormal swellings) on these woody parts. The galls may develop and grow as a single rounded swelling or in large groups often resembling cauliflower-like structures. These galls are smooth and often covered with normal bark. Affected trees lack vigour. The only citrus species on which galls do not develop and affect their growth even if budded onto severely galled rootstocks are orange and mandarin. (See Figs 1-3 for symptoms)

Control

As like other viruses described, both the Xyloporosis and Vein enation-woody gall viruses may be controlled by using virus-free budwoods. Therefore, obtain budwoods only from reputable sources which carry out virus indexing programmes. In orchards, select budwoods only from healthy, mature trees with no symptoms on them. In the case of vein enation-woody gall virus, if both aphids: the green peach aphid *Myzus persicae* and the black citrus aphid *Toxoptera citricidus* are present in the orchard already with this virus, satisfactory control can be obtained by spraying with insecticides.

Checklist of some economical important Viral Diseases of Citrus (diseases marked with an asterisk (*) have been recorded from PNG.)

Diseases	Causal agent	Attacks	Spread by
VIRAL DISEASES			
*Tristeza	Virus	Branches, trunks, fruits.	Infected buds and rootstocks and aphids.
*Exocortis and gummy pitting	Virus	Trunks	Infected buds.
*Psorosis complex.	Virus	Trunks, twigs and leaves	Infected buds and seed transmission only on Carrizo Citrange and trifoliate orange.
Citrus dieback	Virus	Trees, roots	Infected buds
*Xyloporosis	Virus	Trees, trunks, leaves	Infected buds.
*Woody gall and vein enation	Virus	Trunks, branches	Infected buds and aphids.
Stubborn disease	Virus	Trees, fruits, leaves	Infected buds.
Impietratura	Virus	Fruits	Infected bud.

Figure 1. **Marsh variety grapefruit on PNG Muli or lime seedling rootstock suspected of infection by severe strain of Tristeza citrus virus. Note lopsided distortion of fruit (left) and pitting of wood (right).**

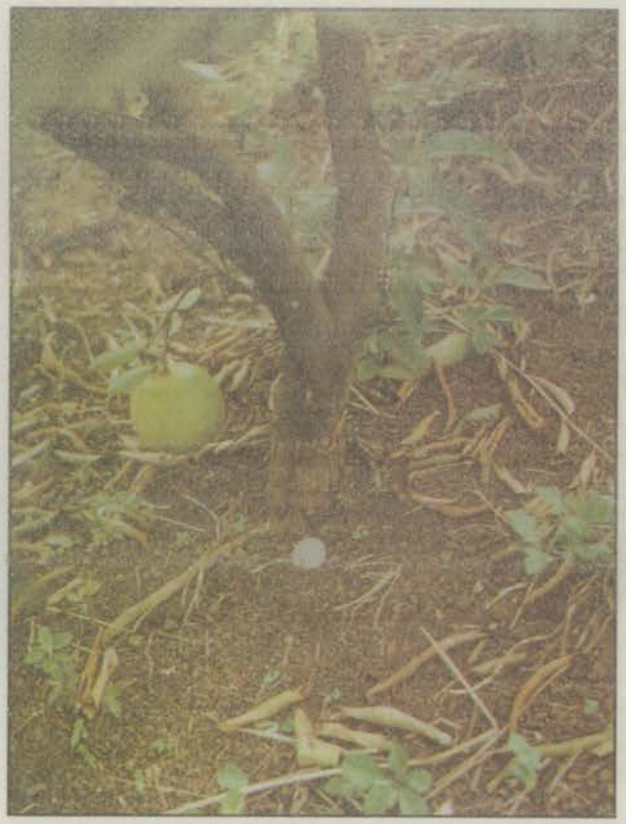

Figure 2. **Exocortis virus infection showing cracking and scaling sysmptoms on the bark below the bud union. Infection mainly occurs on the rootstocks. Note the Satsuma mandarin variety on *P. trifoliata rootstock* (left) and Sweet orange variety also on *P. trifoliata* rootstock (right). Note the degree of scaling of rootstocks on 5 year (left photo) and 7 year (right photo) old infected trees.**

Figure 3. **Vein enation-woody gall infection on five years old Navel orange on rough lemon rootstock. Notice the "woody gall" symptom at the base of the rootstock.**

REFERENCES

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Please, be advised that the bottom right hand picture (Figure 2) on page 8 should be Figure 3 replacing the picture on page 9. The picture on page 9 (Figure 3) should replace the bottom right hand picture on page 8.

We apologise for the inconvenience caused.

Best wishes !!

Editor-in-Chief