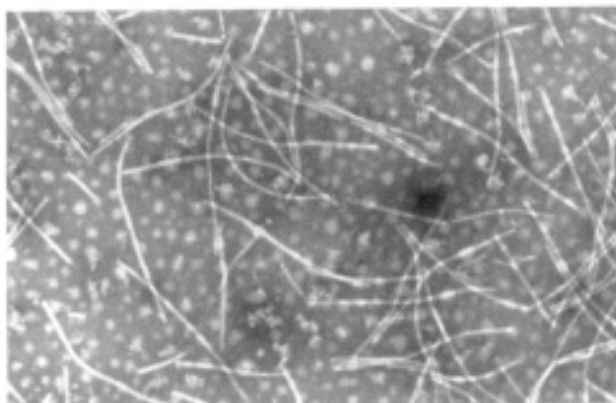


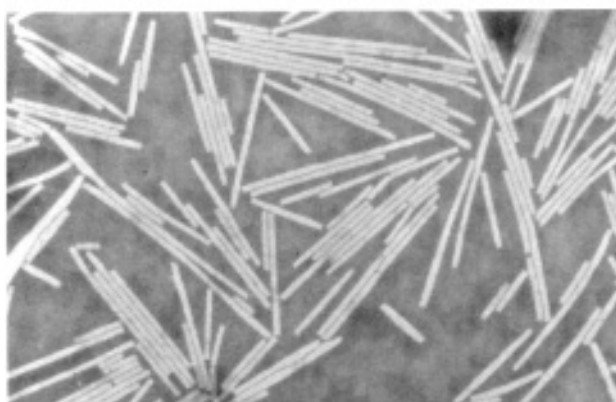
KO E MAHAKI VAILASI 'O E VANILA' VIRUS DISEASES OF VANILLA IN TONGA



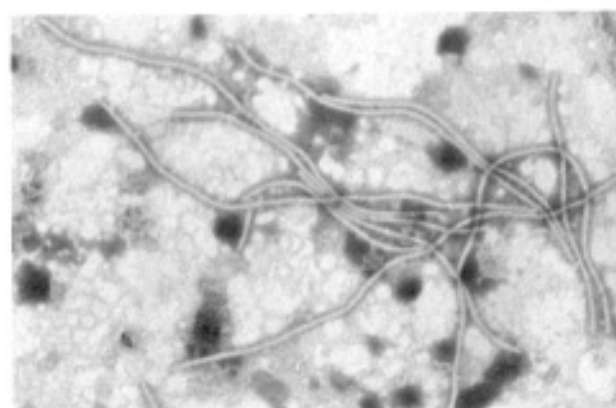
Fika 1. Ko e fõtunga 'o e vanila 'oku ma'u 'e he vailasi' (fakatokanga'i e mate 'a e ngaahi va'a vanila'.
Fig. 1. Disease symptoms on virus infected vanilla (note dying, leafless vines to left of photograph).



CyMV
Cymbidium mosaic virus



ORSV
Odontoglossum ringspot virus



VPV
Vanilla potyvirus

Fika 2. Ko e ngaahi vilasi 'e 3 'o e vanila' (liunga 50,000).

Fig. 2. The three viruses found in vanilla (magnification x 50,000).

Ko e ngaahi vailasi 'i he Vanila'.

'Oku lahi 'a e ngaahi mahaki kehekehe 'o e vanila' 'i Tonga ni' 'a ia 'oku fakatupu 'e he ngaahi vailasi moe fangikasi foki. Koe ki'i pou pou ko'eni' 'e 'oatu ia fekau'aki moe vailasi koia 'oku nau fakatupu 'a e mahaki 'o e Vanila'. 'Oku toe iiki ange 'a e vailasi' 'i he pekitēlia' moe fangikasi', pea neongo te tau lava 'o sio ki he'ene uesia 'etau ngoue Vanila', ka he 'ikai te tau lava 'o sio ki he vailasi' ta'engāue'akj ha me'a faka'ataefu mālohi 'aupito. 'Oku taumu'a 'a e fale'i'ni ke tau tokanga 'aupito ki he mahaki vailasi'ni koe'uhi hei'kai lava hano faito'o 'o kapau 'e ma'u ho'o vanila' 'e he mahaki'ni.

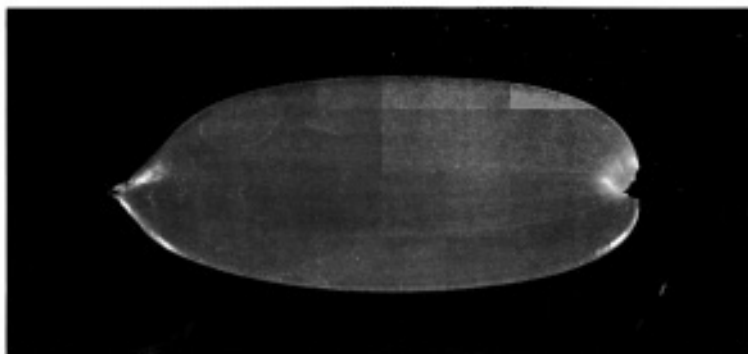
Ko ngaahi vailasi kehekehe 'e tolu ne ma'u 'i he Vanila' (vakai ki he fika 2). (i) CyMV (ii) ORSV (iii) VPV. Koe CyMV moe ORSV 'oku 'iloa kināua he'ena fakatupu mahaki 'i he 'ōketi fakasanisani' 'i he 'ū fonua lahi 'o māmani, pea kuo 'osi ma'u foki kināua 'i he Vanila 'a Fisi', Tahiti, pea mo Tonga'ni. Ko e VPV 'oku ma'u ia 'i Tonga'ni pea mo Fisi. 'Oku 'i ai foki moe vailasi kāinga ofi moe VPV 'i Tonga ni' kuo 'osi ma'u 'i Tahiti ka'oku na kehekehe si'i pē.

The viruses

There are several diseases of vanilla in Tonga caused by both viruses and fungi. This leaflet will deal only with the viruses, which are minute pathogens many times smaller than either fungi or bacteria. Although the symptoms of virus infection can be seen in the plant, the viruses themselves can only be observed with the aid of an electron microscope. Recently discovered virus diseases of vanilla are causing great concern because vanilla plants can not be cured of virus infection.

Three distinct viruses have been found in vanilla in Tonga (Fig. 2):- (i) **Cymbidium mosaic virus (CyMV)**, (ii) **Odontoglossum ringspot virus (ORSV)**, and (iii) **Vanilla potyvirus (VPV)**.

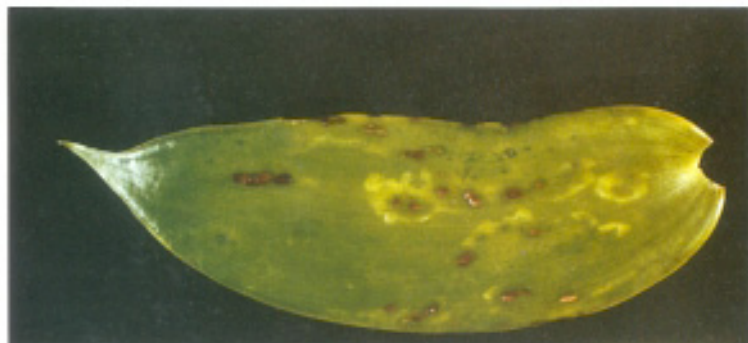
CyMV and ORSV are commonly found in ornamental orchids worldwide and have also been found in vanilla in Fiji and Tahiti. The vanilla potyvirus, which has not yet been named, has been found in both Tonga and Fiji. A potyvirus has also been found in *Vanilla tahitensis* in Tahiti but this is serologically distinct from the virus in Tonga.



Fika 3. Lau'i vanilla mo'ui lelei
Fig. 3. Healthy vanilla leaf.



Fika 4. Ko e fôtunga 'o e lau'i vanilla mui 'oku ma'u 'e he vailasi' (VPV)
Fig. 4. Early virus symptoms on young vanilla leaf.



Fika 5. Ko e fôtunga 'o e lau'i vanilla matu'otu'a 'oku ma'u 'e he vailasi' (VPV)
Fig. 5. Advanced stage virus symptoms on older vanilla leaf.

Koe ngaahi faka'ilonga hono ma'u 'e he vailasi' ho'o vanila'.

1. 'Asi 'a e fanga ki'i 'ila engeenga 'o ki'i luo ki loto 'i he lau'i vanila fo'ou' (vakai ki he taa fika 4), pea vave 'a e fōlipa 'a e lau' 'o kehekehe ia moe lau'i vanila mo'ui lelei' (fika 3).
2. 'Ihe ngaahi lau motu'a ange''e kamata ke mole 'a e fōtunga totonu 'oe lau'i vanila' pea 'asi moe fanga ki'i pala lanu 'uli'uli iiki he lau' (tā fika 5). 'Oku fa'a tolonga pē 'a e mo'ui 'a e ngaahi fu'u vanila 'oku 'asi ai 'a e ngaahi faka'ilonga ko'eni' kae lahi taha 'a e ta'e fua', pea fa'a mate vave atu pē 'a e ngaahi fu'u vanila 'e ni'ihi.
3. 'E fa'a vave pē 'a e mate 'a e fu'u vanila' 'o kamata mei he muka' pe koe mate 'a e lau'i vanila' kae toe pē 'a e fo'i kau'i vanila', 'a ia 'e fa'a huli mai pē ka he'ikai tolonga kuo toe mate.
Koe lahi taha 'ene 'asi he taimi 'e ni'ihi koe fanga fo'i pala pē he kau'i vanila' pea taimi 'e ni'ihi he lau', 'a ia 'e fa'a māhina 'e tolu ki he ta'u hono fuoloa' pea toki mate.

Koe ngaahi fu'u Vanila 'oku hā ai 'a e ngaahi faka'ilonga 'i 'olunga' 'oku ma'u ia 'ehe VPV fakataha he taimi 'e ni'ihi mo e ORSV pe CyMV pē kotoa kinautolu. Koe vanila 'oku ma'u 'e he vailasi'ni 'e tolu 'oku toe 'ilonga ange 'a e 'ū faka'ilonga'ni. Koe CyMV moe ORSV 'oku 'ikai te na uesia lahi 'a e fu'u vanila'. 'Oku fa'a 'ilonga pē 'ena ma'u 'a e fu'u Vanila' 'aki 'a e 'ile'ila 'o hangē 'oku engeenga' 'a e lau'.

Disease symptoms

1. The first symptoms seen in new growth consist of irregular chlorotic (yellow) patches on leaves which also develop an uneven surface and wavy edges (Fig.4). Unlike healthy leaves which are a uniform green colour and flat with smooth edges (Fig.3).
2. In older leaves distortion is more severe and brown scab-like spots appear together with necrotic (brown) areas on the vines (Fig.5).
3. Eventually the vine starts to die, either from the tip or the leaves die leaving a bare vine (Fig.1). New shoots may come up but eventually these will also die. It may take a period of three months to a year for the whole vine to die.

Plants with the above symptoms invariably contain the vanilla potyvirus either alone or together with ORSV and/or CyMV. Plants with all three viruses frequently exhibit more severe symptoms.

A less serious symptom that may be seen is mottling (diffuse yellow patches) on the leaves of plants which are otherwise growing quite normally. These symptoms are often associated with either CyMV and/or ORSV without the potyvirus.

Koe anga 'o e mafola 'a e mahaki vailasi'.

1. 'Oku malava ke ma'u 'e he mahaki vailasi' 'a e kongā kotoa pē 'o e 'akau'ni he 'oku mafola pē ia 'i loto he fu'u vanila'. Ka to'o ha pulopula mei ha fu'u vanila 'oku ma'u 'e he ngaahi faka'ilonga 'i 'olunga' 'e ma'u ai pē 'e he vailasi' 'a e ngaahi fu'u vanila tō fo'ou ko ia'.
2. 'Oku fetuku holo foki 'a e ngaahi vailasi'ni 'i he huhu'a 'o e vanila'. Kapau teu fakatefito pe fakapatu ha fu'u vanila mahaki'ia 'aki hano paki'i ha lau'i vanila pe tu'usi ha muka'i vanila 'o tau e to'i' hoku nima', pe ko'eku hele', pea u hiki 'o ngāue ki ha fu'u vanila mo'ui lelei teu 'ave ai pē 'a e vailasi' ki he vanila mo'ui lelei'.
3. Koe VPV 'oku lava ia 'o fetuku holo 'e he fanga ki'i kutu iiki koe 'eifiti, 'ai a 'oku 'ikai te nau lava 'o fetuku holo 'a e CyMV moe ORSV. 'Oku 'ikai manako 'a e 'eifiti' ki he Vanila' ka 'oku malava ke nau fetuku 'a e VPV mei he fu'u vanila ki he fu'u vanila 'i he taimi 'e ni'ihī.

'I he ngaahi 'a' ahi ne fai ki he ngaahi ngoue'anga vanila lolotonga e ta'u 'e ua ku'o hili', ne 'ilo ai 'oku fakautuutu 'a e 'asi 'a e mahaki'ni 'i he ngaahi ngoue'anga Vanila 'e ni'ihī. Ko ia 'oku mahu'inga ke ta'ofi 'a e mahaki'ni ke 'oua 'e toe mafola atu ki he ngaahi ngoue'anga 'oku kei hao'.

Infection and spread

1. The viruses found in vanilla can spread within the plant and will usually be found in the new growth. Consequently any cutting taken from a diseased plant can produce diseased plants even when the cutting itself shows no obvious disease symptoms.
2. All three of the viruses found in vanilla are mechanically transmissible. Sap from a diseased plant can therefore cause infection if transferred to a healthy plant by a worker's hands or tools.
3. The potyvirus can also be spread from plant to plant by some aphid species. Although aphids are uncommon on vanilla in Tonga short visits by aphids from weeds or other crops may contribute to virus spread.

Observations in Tonga over the past two years indicate that the incidence of virus disease is increasing in some plantations. However, many plantations are still free of virus disease and it is important that the spread of virus to these crops is prevented.

Koe ngaahi founga faka'ehi'ehi 'eni 'e lava ke malu'i 'aki ho'o ngoue vanila' mei he mahaki vailasi'.

1. To'o ma'upē ho'o pulopula' mei ha fu'u Vanila mo'ui lelei mo 'āfa'afa. 'Oua 'aupito 'e to'o e pulopula' mei ha fu'u vanila 'oku 'asi ai 'a e 'ū faka'ilonga 'o e mahaki'.
2. Koe fu'u vanila kotoa pē 'oku 'asi ai 'a e 'ū faka'ilonga 'i he tā (fika 1, 4 moe 5) 'oku totonu ke ta'aki 'o faka'auha 'aki hano tutu pe tanu. 'Oua 'e toe tuku 'i he loto ngoue' hē 'e mafola mei ai 'a e mahaki' ki he vanila mo'ui lelei'.
3. Kapau kuo ke 'osi ngāue ki he vanila mahaki'ia' pea fufulu ho nima' ke ma'a 'aki ha vai mo ha koa pea ke toki ngāue ki he vanila mo'ui lelei'. Ko e hele 'oku ngāue'aki ki he fakapatu'pē 'oku tau ai 'a e to'i mei he vanila mahaki'ia' 'oku totonu ke āngaki 'i ha afi ha miniti nai 'e taha. 'Uluaki ngāue ma'u pē ki ho'o vanila mo'ui lelei' pea toki ngāue ki he vanila mahaki'ia'.
4. Huo pea ta'aki ma'u pē 'a e vao'mei he ngoue'anga vanila'. 'Oku 'uhinga eni ki he iku'i kumā, saafa, kola, moe ngaahi vao pehe'kae tautautefito ki he Longolongo'uha' 'ai a 'oku lata ki ai 'a e kutu'. 'Oku kei lelei pē ke tauhi fakataha 'a e mohuku vailima' mo e vanila' ka kuopau ke ta'aki 'a e vao kehe kotoa pē pea ke 'oua foki 'e fu'u loloa 'a e vailima' pe kaka 'i he fu'u vanila'.

MANATU'I:- Fetu'utaki leva ki he 'ōfisa fale'i ki he ngoue 'i ho vahe' 'o ka 'ikai ke mahino ha me'a fekau'aki mo e vailasi' pē ko ha toe mahaki kehe 'o e vanila'.

Control measures

1. Take cuttings **ONLY** from healthy, vigorously growing plants. **NEVER** use cuttings from any part of a plant with disease symptoms or even a plant suspected of being diseased.
2. **ALL** plants with the disease symptoms shown in the photographs (Figs.1, 4 & 5) should be pulled out and burnt or buried immediately. Do not leave diseased plants in the plantation as these will act as a source of virus to infect other plants.
3. If you have handled diseased plants thoroughly clean your hands with soap and water before you next work with healthy plants. Cutting tools which have been used on diseased plants should be sterilised by heating in a flame for one minute.
4. The vanilla crop should also be kept free of all weeds, especially those on which aphids are found (e.g. *Emilia sonchifolia* & *Sonchus olearaceus*).

REMEMBER:- Contact your MAFF District Advisory Officer (or Plant Pathologist, Research Division, MAFF) for clarification on any aspect of this bulletin or queries on other diseases of vanilla.

Further reading

Pearson, M.N. & Pone, S.P. Viruses of vanilla in the Kingdom of Tonga. *Australasian Plant Pathology* (in press).

Wisler, G.C., Zettler, F.W. & Mu, L. (1987). Virus infections of vanilla and other orchids in French Polynesia. *Plant Disease*, 71, (12), 1125-1129.

This leaflet was prepared by S.P. Pone of the Tongan-German Plant Protection Project, P.O. Box 881, Nuku'alofa, Tonga and Dr. M.N. Pearson, Dept. of Botany, University of Auckland, New Zealand. This publication was made possible through the financial support of the Tongan-German Plant Protection Project (Deutsche Gesellschaft fuer Technische Zusammenarbeit, G.T.Z.). The authors wish to thank Mr Haniteli Fa'anunu (Vanilla Project Manager) and the many members of the M.A.F.F. staff who contributed to this leaflet by their comments and suggestions during the drafting stage. The recommendations included in this leaflet are based on current research results and may be updated in the light of future results.