Data Sheets on Quarantine Pests

Satsuma dwarf 'nepovirus'

IDENTITY

Name: Satsuma dwarf 'nepovirus'
Synonyms: Citrus mosaic virus (but see Notes on taxonomy below)
Taxonomic position: Viruses: Comoviridae: Possible *Nepovirus*
Common names: SDV (acronym)
Toramikan (Japanese)
Notes on taxonomy and nomenclature: In Japan, a well characterized virus causing 'citrus mosaic', serologically related to SDV, is now considered to be a strain of SDV. Navel orange infectious mottling virus and natsudaidai dwarf virus, also serologically related, are possibly also strains of SDV (Tanaka & Imaka, 1976). A citrus mosaic 'virus' (CiMV) has also been described in India (Dakshinamurti & Reddy, 1975; Ahlawat *et al*., 1985) but is not known to be related to SDV. It has very recently been characterized as citrus mosaic badnavirus (EPPO/CABI, 1996).
EPPO computer code: CSSDXX
EPPO A2 list: No. 279
EU Annex designation: II/A1 - as Satsuma dwarf

HOSTS

The principal host is satsumas (*Citrus unshiu*), on which the symptoms have most commonly been observed. However, most species of citrus can be infected by grafting and some by mechanical transmission (Tanaka, 1972). Serious symptoms have recently been reported on navel cultivars of oranges (*Citrus sinensis*), possibly due to a new strain (Iwanami *et al*., 1991). Many citrus relatives including *Poncirus* and *Fortunella* can also be hosts. Other Rutaceae (*Citrus hassaku*, *C. latifolia*, *C. medica*, *C. reticulata* x *C. paradisi* cv. Orlando) are symptomlessly infected. A few non-rutaceous species are susceptible on artificial inoculation: cowpeas (*Vigna unguiculata*), *Nicotiana tabacum*, *Phaseolus vulgaris*, sesame (*Sesamum indicum*), while others are symptomlessly infected: *Chenopodium amaranticolor*, cucumbers (*Cucumis sativus*), *Nicotiana glutinosa*.

GEOGRAPHICAL DISTRIBUTION

EPPO region: Turkey (Azeri, 1973).
Asia: China (Zhejiang; Cui *et al*., 1991), Iran, Japan (Honshu, Kyushu, Shikoku), Korea Democratic People's Republic, Korea Republic. The citrus mosaic strain has been reported only from Japan.
EU: Absent.

BIOLOGY

SDV is transmitted by grafting (Ushiyama, 1981), but is also mechanically transmitted under artificial conditions (Tanaka & Imada, 1974). Field observations suggest that the disease is slowly transmitted from tree to tree presumably through soil, although no vector

has been identified. It is thought that *Viburnum odoratissimum* may act as a reservoir for infection.

Citrus mosaic is considered to be a strain of SDV because of similarity of symptoms on herbaceous hosts and other properties including serology (Imada *et al*., 1977; Usugi *et al*., 1986). It was first described as a virus by Ishigai & Jinno (1958), long after recognition of a fruit disorder of unknown origin. It was originally reported only to occur in Wakayama prefecture. However, recent study has revealed that citrus mosaic is widespread all over Japan.

DETECTION AND IDENTIFICATION

Symptoms

On citrus, SDV typically causes small boat or spoon-shaped leaves. General symptoms are enations, multiple flushing, stunting or dwarfing, reduction in number and size of leaves and shoots, shortened internodes, and small-sized fruits with thick peel. Fruit production can be seriously reduced.

The citrus mosaic strain is characterized by causing particular symptoms on fruits. On satsumas, these are green blotches or ring-shaped spots on the rind at colour break and delayed colouring of the spotted area. Fruit symptoms also appear on lemons and *Citrus obovoidea*, but not typically on oranges, although fruit quality is reduced on this host. However, some isolates which are serologically closer to the citrus mosaic strain than to SDV do not induce mosaic symptoms on fruit of satsuma (Iwanami *et al*., 1993). There are thus differences between severe and mild strains in induction of fruit symptoms.

Morphology

SDV, including the citrus mosaic strain, is an isometric virus approximately 26 nm in diameter, containing two species of polypeptide of MW about 42 K and 23 K (Iwanami *et al*., 1993). The virions encapsulate two species of RNA of about 7.0 kb and 5.4 kb both of which have a poly(A) sequence at the 3' end. For more information on properties of SDV, see Usugi & Saito (1977, 1979).

Detection and inspection methods

White sesame is the best herbaceous indicator plant for SDV. The citrus mosaic strain can be detected from young tender leaves of spring flush by ELISA using polyclonal antibodies produced against it (Usugi & Tsuchizaki, 1982). ELISA is extremely helpful in large-scale detection. However, it should not be used as the only method for the testing of mother trees because it sometimes gives false negative results. ELISA can be used in conjunction with mechanical transmission to sesame to ensure that important budwood or mother tree is free from SDV. ELISA with monoclonal antibodies can be used to distinguish the citrus mosaic strain from other SDV (Nozu *et al*., 1986).

MEANS OF MOVEMENT AND DISPERSAL

SDV (including its citrus mosaic strain) is readily transmitted by grafting. Soil transmission is also suggested (Isoda & Gyoutoku, 1990), but results are not confirmed. The existence of the vector is still unknown. In international trade, SDV is most likely to be carried in infected budwood.

PEST SIGNIFICANCE

Economic impact

Trees infected by SDV are stunted, with reduced yield. Fruits on trees severely affected by the citrus mosaic strain are of poor quality and low commercial value. The citrus mosaic strain has been spreading and increasing in importance in Japan (Yamaguchi, 1984).

Control

It is essential to use virus-free budwood for the propagation of new trees. Though field observation suggests the transmission of SDV through soil, soil fumigation is not effective (Isoda *et al*., 1991).

Phytosanitary risk

SDV was recently added to the EPPO A2 list, but has not been considered as a quarantine pest by any other regional plant protection organization. The virus typically infects satsumas (*C. unshiu*), rather than other citrus, and this species is not widely grown in the EPPO region. In Turkey, where satsumas are grown in the Aegean region, and where SDV has been introduced presumably with budwood imported from the Far East, the virus has only been reported on this species. It does not appear to have spread to other citrus, or to other regions of Turkey, or elsewhere in the EPPO region. No vector is known for certain in the Far East, and no vector appears to occur in the EPPO region. Thus, SDV does not seem to present a very high risk for the EPPO region. However, it has been reported from other citrus, and the citrus mosaic strain seems to be increasing in importance in Japan. So, it seems justified to prevent further spread of SDV, and in particular introduction of new strains from the Far East.

PHYTOSANITARY MEASURES

SDV already occurs in the EPPO region, but does not seem to present a major risk in its present form. So, within the EPPO region, citrus planting material should be certified free from SDV by methods such as those of the EPPO certification scheme for citrus (OEPP/EPPO, 1995). Since SDV in the Far East includes forms such as the citrus mosaic strain and others, with a wider host range in practice, import of citrus planting material from these origins should be prohibited. This is already so on account of a number of more serious citrus pests, e.g. citrus greening bacterium and citrus tatter-leaf capillovirus (EPPO/CABI, 1996).

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