Watermelon silver mottle tospovirus

IDENTITY

Name: Watermelon silver mottle tospovirus
Synonyms: Watermelon silver mottle virus
Watermelon silvery mottle virus
Watermelon tospovirus
TSWV-W
Taxonomic position: Viruses: *Bunyaviridae*: *Tospovirus*: serogroup IV
Common names: WSMV (acronym)
Watermelon silver mottle disease (English)
Notes on taxonomy and nomenclature: WSMV has previously been described as a strain of tomato spotted wilt tospovirus (TSWV) (Iwaki *et al*., 1984), as TSWV-W (Kameya-Iwaki *et al.*, 1988; Singh & Krishnareddy, 1995) and as Tospo-W (Yeh & Chang, 1995). It is now recognized as a distinct member of the genus *Tospovirus* (Yeh & Chang, 1995; Yeh *et al*., 1997), related to peanut bud necrosis tospovirus (PBNV) and watermelon bud necrosis tospovirus (Jain *et al*. 1998) in India.
Bayer computer code: WMSMOX
EPPO A1 list: no. 294
EU Annex designation: not specifically included, but WSMV had not been distinguished from TSWV at the time the latter was included in Annexes I/B and II/A2.

HOSTS

WSMV naturally infects only two significant crop plants, the cucurbits watermelon (*Citrullus vulgaris*) and melon (*Cucumis melo*). Chen *et al.* (1995) isolated a tospovirus from naturally infected plants of *Benincasa hispida* (wax gourd) (*Cucurbitaceae*) in Taiwan which appeared to be a strain of WSMV based on serological tests and transmission by *T. palmi*. Hsu *et al.* (1996) have recovered a tospovirus (HT-1) from a gloxinia plant (*Gesneriaceae*) in the USA, which is serologically related to WSMV from Taiwan. Tsuda *et al*. (1997) isolated a tospovirus from *B. hispida,* which they identified as more closely related to WSMV than to TSWV.

WSMV has also been transmitted experimentally, both mechanically and by viruliferous *Thrips palmi* and other *Thrips* spp. , to a number of other hosts. Iwaki *et al.* (1984) transmitted WSMV (then known as a strain of TSWV) from mechanically infected *Nicotiana glutinosa* to 22 plants in 6 families (*Cucurbitaceae, Solanaceae, Aizoaceae, Amaranthaceae, Fabaceae, Chenopodiaceae*), out of 37 species in 9 families tested. Yeh *et al.* (1992) conducted similar tests using the related Taiwanese watermelon isolate of WSMV (TSWV-W).

GEOGRAPHICAL DISTRIBUTION

EPPO region: absent.
Asia: India (possibly, Singh & Krishnareddy, 1995), Japan (Iwaki *et al*., 1984), Taiwan (Yeh & Chang, 1995).
South America: reported but not confirmed in Brazil (Boiteaux *et al*., 1994).
EU: Absent.

BIOLOGY

The biology of WSMV is similar to that of TSWV (OEPP/EPPO, 1999). Like TSWV, it is transmitted by thrips, and, in particular, by the Asiatic species *Thrips palmi* (Yeh *et al.*, 1992). Transmission studies on *Frankliniella occidentalis* and *Thrips tabaci* indicate, however, that these thrips species present in the EPPO region are not capable of transmitting WSMV (Barker, pers. comm.). Singh & Krishnareddy (1995) described the Indian isolate of TSWV-W as being transmitted (presumably in laboratory tests) by *Thrips flavus*. As far as is known, the “thrips-tospovirus relationship” referred to by Mumford *et al*. (1996) also applies to WSMV, so it may be supposed that only larval thrips can acquire WSMV, but the virus then persists within the thrips for the duration of its life. Like TSWV, WSMV is not seed-transmitted.

DETECTION AND IDENTIFICATION

Symptoms

Iwaki *et al.* (1984) described affected watermelons in Japan with silver mottling on leaves and chlorotic mottling on fruits that were malformed. Yeh *et al.* (1992) described field symptoms on watermelon in Taiwan. Affected plants were severely stunted, had shortened internodes, upright growth of younger branches, tip necrosis and dieback. Foliar symptoms included mottling, crinkling, yellow spotting and narrowed leaf laminae. Fruits were small and malformed and exhibited necrotic spots or silver mottling. Fruit set was reduced. Symptoms on melon were described as foliar mottling, plant stunting, upright growth of branches and tip blight.

Morphology

As for TSWV (OEPP/EPPO, 1999).

Detection and inspection methods

Serological techniques are currently used to detect WSMV. Yeh & Chang (1995) showed that viral nucleic acids extracted from Tospo-W-inoculated plants (WSMV) could be easily detected by dot-blot assay with a ^{32}P-labeled cDNA probe.

MEANS OF MOVEMENT AND DISPERSAL

WSWV is liable to spread naturally with its vector *T. palmi* (EPPO/CABI, 1996). Internationally, it could be carried by susceptible host plants, but these are not generally traded between continents.

PEST SIGNIFICANCE

Economic impact

Yields of watermelon and melon can be significantly reduced when plants become infected with WSMV, but no precise figures are currently available. Iwaki *et al.* (1984) described considerable reductions in yield and quality of infected watermelon in Japan, but there is no more recent information. Yeh *et al.* (1992) described reduced fruit set in affected watermelon plants in Taiwan and the fruit that developed was small and malformed. They considered the virus to be widespread throughout Taiwan and one of the major limiting factors for melon and watermelon production. Singh & Krishnareddy (1995) described TSWV-W infection of watermelon in India as causing damage of “up to 100%” when early infection occurred. Boiteaux *et al.* (1994) speculated that the new disease of melon in Brazil (which they described as being caused by a tospovirus isolate serologically distinct from TSWV) may be severe in commercial melon plantings especially as the natural population of thrips vectors increases dramatically in central Brazil during the dry season.

Control

The main strategy for controlling WSMV is to control its vector, *T. palmi*. However, controlling *T. palmi* by chemical means is difficult both in the field, and especially in glasshouses. Imidacloprid and pyrethroids are used but may affect natural enemies (Nemoto, 1995). The most effective insecticides in Martinique on outdoor vegetables were profenofos, avermectin and carbofuran (de Bon & Rhino, 1989). Glasshouse trials in Japan never resulted in more than 80% mortality, and additional cultural and mechanical methods were needed (Yoshihara, 1982; Kawai, 1990). Resistant strains may result from extensive use of chemicals, such as imidacloprid.

Biological control of *T. palmi* is not considered to be achievable (EPPO/CABI, 1996) but various investigations have been conducted, mainly using anthocorid bugs (*Orius* sp.) (Nagai *et al.,*1988; Kawai, 1995) and mites (*Amblyseius* spp.) (Kajita, 1986). Green *et al.* (1996) tested *Lycopersicon* and *Capsicum* spp. with resistance to TSWV for resistance to WSMV and identified lines that may be useful for breeding resistance. Little information is available on breeding for resistance in watermelon or melon.

Phytosanitary risk

WSMV presents a clear risk to crops of watermelon and melon in the EPPO region. These are widely grown, mainly in Mediterranean countries, but also in glasshouses in northern countries. Other cucurbits can be experimentally infected with WSMV, but are not recorded as hosts in the countries where the virus occurs. Although cucumber, widely grown in the EPPO region, may appear as an important potential host, it should be noted that this crop is also widely grown in Japan, without being infected by WSMV. Other tospoviruses which are quarantine pests for the EPPO region (TSWV and INSV) have wide natural host ranges, and it is not clear what makes WSMV have a natural host range which is so much narrower than its experimental host range.

WSMV would need a vector in the EPPO region to express its damage potential. Its only known vector *T. palmi* is absent from the EPPO region, and is indeed an A1 quarantine pest. The possibility that *T. palmi* might carry WSMV and indeed other non-European tospoviruses is another important element in the risk presented by this species. It is also possible that other thrips might become vectors of WSMV if it were introduced. It may be recalled that TSWV was an insignificant virus with a limited natural host range, and INSV was completely unknown, until the vector *F. occidentalis* revealed the pest potential of these viruses.

PHYTOSANITARY MEASURES

As host plants of WSMV are little traded between continents, the main phytosanitary measure to be taken against WSMV is to exclude its vector *Thrips palmi* (EPPO/CABI, 1996).

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