Raspberry Bushy Dwarf Virus

a. Virus/pathogen name, including accepted acronyms and synonyms

Raspberry bushy dwarf virus, RBDV- Genus *Idaeovirus, Mayoviridae* , Martellivirales

b. Host range, including resistance or tolerance within the crop hosts, alternate hosts

RBDV was believed to naturally infect only *Rubus* sp. until 2003, when it was found to infect grapevine (*Vitis vinifera)* in multiple vineyards in Slovenia (Mavrič Pleško et al., 2009, 2003). However, RBDV can experimentally infect numerous herbaceous species from different families, such as *Amaranthaceae, Chenopodiaceae, Leguminosae, Cucurbitaceae* and *Solanaceae.* Plants belonging to *Chenopodium spp.* especially *C. quinoa*, are often used for virus propagation because it is easy to diagnose symptoms for RBDV and the virus reach high titer (Barnett and Murant, 1970; Mavrič Pleško et al., 2009). Raspberry cultivar Willamette was believed to be resistant to RBDV until appearance of the resistance-breaking isolates (Dulic-Markovic and Rankovic, 1992). Genetic resistance has been incorporated in raspberry cultivar Meeker (Malowicki et al., 2008),

b. Symptoms on crop host including varietal differences with images of symptoms when available

Infection in most of the *Rubus* spp. caused by RBDV is symptomless. However in sensitive cultivars virus can cause leaf curling, necrosis, premature defoliation, stunting, decreased vigor and druplet abortion leading to crumbly fruit (Jevremovic and Paunovic, 2015; Murant et al., 1974). In mixed infection with *Black raspberry necrosis virus* (BRNV), RBDV causes raspberry bushy dwarf disease, decreasing plant size and fruit yield (Jones, 1979). The interaction between *Raspberry mottle virus* (RLMV) and RBDV was noticed when plants were showing increase severity of crumbly fruit disease, when both viruses were present in plants (Quito-Avila and Martin, 2012). Symptoms in grapevine appear as curved line patterns and yellowing of the leaves (Mavrič Pleško et al., 2003).
Symptoms in herbaceous plants mostly include necrotic and chlorotic lesions on leaves. On *C. quinoa* symptoms are followed by light and dark green mosaic and ring patterns on leaves (Barnett and Murant, 1970).

d. Geographic distribution:

RBDV is found worldwide, wherever *Rubus* spp. are grown. It has been reported in Europe (Mavrič Pleško et al., 2003; Milusheva et al., 2012), New Zealand (Jones and Wood, 1979), Asia (Chamberlain et al., 2003), North America (Ellis et al., 2005), South America (Quito-Avila et al., 2013), Australia (Guy et al., 1982) and Africa (Kooyman et al., 1982).

e. Means of spread:

RBDV is in *Rubus* spp. naturally spread by pollen and seed (Murant et al., 1974), but Mavrič Pleško et al (2009), in their study indicate that in grapevine RBDV is not seed transmissible. Mechanical and sap inoculation were achieved to several herbaceous hosts such as *Chenopodium quinoa* and *Chenopodium murale*, which are often used for mechanical inoculation (Barnett and Murant, 1970; Isogai et al., 2012; Mavrič Pleško et al., 2009; Milusheva et al., 2012). Vector for this virus is not known, but in 2009, Mavrič Pleško et al. detected RBDV in nematode *L. juvenilis* found in soil where infected plants where grown. Further studies needs to be taken in order to determine the role of this nematode in the RBDV transmission (Mavrič Pleško et al., 2009)

f. Recognized diagnostic tests with cited references:

RBDV has been detected by enzyme linked immunosorbent assay (ELISA) (Barbara et al., 1984) (Milusheva et al., 2012) immune-capture (IC) RT-PCR (Mavrič Pleško et al., 2009), reverse transcription polymerase chain reaction (RT-PCR), real-time PCR (Quito-Avila and Martin, 2012) and nested PCR (Jevremovic and Paunovic, 2015)

g. Sampling recommendations for each pathogen including timing and tissue to be sampled

In order to detect RBDV in *Rubus* spp. sampling symptomatic leaves is ideal (Chamberlain et al., 2003; Ellis et al., 2005). However, in grapevine RBDV can be detected in leaves, shoot tips, inner bark of stems, petioles, roots and berries (Mavrič Pleško et al., 2009). Since the virus is irregularly distributed in individual infected plants, sampling from different parts of the plant can increase the chance of virus detection (Mavrič Pleško et al., 2009).

h. Management strategies for the pathogen and the vector(s) of the pathogen

Since RBDV is transmitted through pollen and seed, the only effective control method is planting virus resistant cultivars (Malowicki et al., 2008).

i. References

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Date of last update: August 2024