Tobacco Ringspot Virus

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

Tobacco ringspot Virus, TRSV – Genus *Nepovirus,* Family *Secoviridae*, Order *Picornavirales*.

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

TRSV has a broad host range infecting hundreds of plant species. Some of the hosts are blackberry, grapevine (*Vitis vinifera*), blueberry (*Vaccinium corymbosum L.*), elderberry, apple, cherry, cucurbits, dogwood, eggplant, gladiolus, iris, pelargonium, pepper, soybean, *Mentha* sp., and tobacco. TRSV has a wide experimental host range, some of the species that have been used for assay, propagation, or diagnostic purposes are *Cucumis sativus*, *Petunia Hybrida*, *Nicotiana tabacum*, *Nicotiana clevelandii*, *Chenopodium amaranticolor*, *Chenopodium quinoa* and *Phaseolus vulgaris*.

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

Virus symptoms differ between species and cultivars. TRSV is symptomless or produces only mild symptoms in single infections in blackberry but can cause severe symptoms when found in plants co-infected with other viruses. On blackberry, infected plants may show faint to severe ringspots, mottling and mosaic, yellow line patterns, leaf distortion and stunting. On blueberry, TRSV is associated with the disease blueberry necrotic ringspot with susceptible cultivars, as 'Pemberton', exhibiting stem dieback and stunting, with deformed and thickened leaves. Some leaves may become chlorotic and present necrotic spots. Other symptoms, such as, short intemodes and small leaves, may occur in 'Concord' and 'Stanley'. TRSV cause decline in productivity in ' Collins', 'Elliott', 'Jersey', 'Pemberton' and 'Rubel'. In grapevine, cultivar Blanc du Bois shows symptoms of leaf deformation, chlorotic specks, stunted shoots, and general decline.

The symptoms produced by TRSV in the herbaceous indicators are similar to the ones induced by other nepoviruses. *C. sativus* develop symptoms, such as, chlorotic local lesions and systemic mottling or dwarfing and severe apical distortion. In *N. clevelandii* and *N. tabacum*, the virus causes necrotic local lesions that frequently develop into ringspots and systemic ring or line-patterns. Symptoms in *C. amaranticolor* and *C. quinoa* consist in local necrotic dots, systemic reaction is not develop.

d. Geographic distribution:

TRSV was considered a New World virus, but nowadays it has a worldwide distribution, due to the movement of infected plants and soil which may Harbor its vectors. TRSV infecting berries has been detected in the U.S. (Arkansas, Connecticut, Illinois, Michigan, New York, Oregon), Canada (New Brunswick) and Chile.

e. Means of spread:

Natural transmission is by the nematode *Xiphinema americanum,* a complex that may contain more than 20 distinct species. The virus particles adsorb to regions within the nematode esophagus and may be retained and able to be transmitted for long periods. TRSV is known to be pollen and seed-transmitted in some hosts. This virus can also be spread through vegetatively propagated hardwood cuttings.

f. Recognized diagnostic tests with cited references:

TRSV can be detected by serological tests such as enzyme-linked immunosorbent assays (ELISAs); antibodies are commercially available (Fuchs et al., 2010, Shiel & Castello, 1984). These viruses have broad host ranges and can be detected by mechanical transmission to a number of herbaceous hosts (Stace-Smith, 1987). Also, full sequences have been obtained for these viruses, enabling their detection by reverse transcription polymerase chain reaction (RT-PCR) (Fuchs et al., 2010, Lee et al., 2015, Leisner & Reiner, 2007) and quantitative RT-PCR (Poojari et al., 2016).

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

TRSV has an uneven distribution in the plants, seasonal differences in virus titer in leaf tissues and varying titers of virus in different parts of the plant. This is why samples should be taken from leaves that are symptomatic and young (3/4 expanded leaves). Also, sampling from different sites of the same plant increases chances of detection. The best time to sample for nepoviruses is early in the growing season. Extra precaution needs to be taken during flowering periods as pollen from infected material may land on TRSV-free material which would test positive for the virus. A thorough wash with water before extraction is recommended.

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

The main management strategy is the use of certified virus-tested planting material. Fumigating soil with nematicides prior to planting and keeping the field free of weeds is essential for removing potential virus reservoirs. Crop rotation can assist in controlling virus spread. Maintaining a cover crop helps minimizing soil movement in the field.

This virus spread very slowly from an infection source and can be controlled by removing infected plants and those surrounding the infection foci; taking care to remove as much of the root system as possible, followed by a spot treatment with a nematicide. Additionally, prior to planting the site should be tested for the presence of X. americanum and the viruses, since the viruses and nematode have broad host ranges and are symptomless in many hosts.

i. References

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Names of reviewers: Ioannis E. Tzanetakis, Robert R. Martin

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